THE

PORTABLE ENCYCLOPÆDIA

OR,

A DICTIONARY

OF

THE ARTS AND SCIENCES,

ON THE BASIS OF DR. GREGORY'S.

COMPREHENDING THE LATEST IMPROVEMENTS IN EVERY BRANCH
OF USEFUL KNOWLEDGE.

Illustrated by Numerous Engravings.

BY JAMES MITCHELL,

MARKET HARBOROUGH.

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PREFACE.

In presenting to the public a work like the present, it is naturally to be expected that the Editor should give some account of the grounds on which he rests his claim to attention; and with this expectation he readily complies. The number of Dictionaries professing to comprehend a general view of the Arts and Sciences, in a condensed form, already extant, is very great; yet, great as it is, it is every year rapidly increasing. The reason of this it is scarcely necessary to specify, since it must be obvious to every one; for who does not know, who does not feel, that the demand for information among all ranks in society has become unparalleled in the history of the world.

To satiate this universal desire for knowledge, the press, free and powerful as it is, is found to be scarcely adequate. Under such circumstances, it is not at all surprising that, amongst the numerous productions with which it teems, much imperfection should be found. Indeed, to expect things to be otherwise, would be to expect that the powers of the human mind should attain to perfection without passing through those *degrees* of developement with which the great Author of nature, and of all order, has inseparably connected so much of our intellectual enjoyment.

Improvement is the very soul of all human effort: remove the hope of this, and you change the gay face of nature, into the cheerless gloom of annihilation. Nay, even viewing man as a being destined for immortality, what were his brightest prospects without the assurance of eternal progression in all that is suited to administer to his delight?

It is on this broad principle that the Editor of the following sheets would wish to advert to the generality of the several works, of a similar nature to his own, already before the public; and while he adopts as his own motto the well-known words—

> "Quod potui perfeci,"

he is well aware that common candour requires that he should admit its applicability to the productions of his fellow-labourers in the field of science. It does not, however, follow from this, that he must shut his eyes against the glaring imperfections of some of them. Comparisons are often invidious, and therefore he forbears to make them; but he thinks it a duty which he owes to the public, to caution them against being imposed on by the specious pretensions of a small book which aims at nothing short of being considered as a scientific companion to Johnson's Dictionary of the English Language! To point out the numerous errors and deficiencies of this volume, which makes such lofty pretensions, would require several pages: it may be sufficient to say, that the language is often highly ungrammatical; the orthography prodigiously incorrect; the printing slovenly; references are often made to articles on which there is not one word said; plates are given without letters of reference to the letter-press; and references are made in the letter-press to plates that do not exist; the plates themselves, with a few exceptions, are coarse woodcuts, in some of which the engraver has shewn his scientific knowledge

by carefully imitating the imperfections of the *worn-out* plates from which he copied. To the above may be added, that the arrangement is often incorrect; and, although the work professes to be a new, a corrected, an enlarged, and improved edition of one known by the name of Watkins's Portable Cyclopædia, it does not contain one column of original writing—no not one solitary paragraph; and the reader will look in vain for one word of information on most of those subjects which mark the rapid progress of science in this country, and in other parts of the world.

These are certainly matters of great importance in a work which professes to put the student in possession of a condensed view of the latest improvements in every progressive science; and which, from its richness of information, the excellence of its execution, and the lowness of its price, has (says the editor,) no parallel in any modern language!

Nor can the editor of the present volume dismiss this subject without adverting to another circumstance, which, although not of essential importance, he has already found operating to his disadvantage, he means the identity of names. It is very true that if the titles appended to a man's name were always certain indications of merit, there might be some honour, even in being mistaken for an L L. D. and an F. A.S.; but the potency of mere titles is now happily expiring:—the *public, as such,* begin to judge of men's powers from their performances; it is on this ground that the Editor of the Portable Encyclopædia takes his stand; and the only thing he solicits from those into whose hands his work may fall, is a close and candid perusal of it.

He lays no claim to perfection: some few typographical errors he perceives have found admission into his pages, but they are of the most unimportant description; and he must say they have occurred in despite of the closest vigilance, most of the proofs having undergone three readings, and some of them four. It has been his constant endeavour to exclude all obsolete and extraneous matter, and at the same time to render the work as comprehensive as possible. Several of the leading articles have been entirely re-written; most of them have been much altered and improved; much original matter has been added; and the whole has been brought down to the latest date. The improvement, however, which the whole has undergone, will be best understood by inspection, which renders a detail of it in this place the less necessary. As to the engravings, it is hoped that both in the choice of the subjects, and in the execution of the workmanship, they will afford the utmost satisfaction; indeed the general appearance of the volume will show that the publisher has spared no expense to render it worthy of public patronage. The Portable Encyclopædia, as the title-page announces, is formed on the basis of Dr. Gregory's "Complete Dictionary of the Arts and Sciences," a work too well known to require any encomium here, and which has only become imperfect in consequence of the vast acquisitions which the arts and sciences have made since it was published. The deficiencies of Dr. Gregory's excellent work the editor has endeavoured to supply from the most modern and best established authorities, to whom he takes this opportunity of expressing his obligation, and of offering his sincere thanks.

In conclusion, the Editor would observe that, while he trusts his work will be found peculiarly serviceable to youth in general, and to the members of Mechanic's Institutions, and to the frequenters of Scientific Lectures in particular, he hopes it will also be of service, as a book of easy and immediate reference, to gentlemen whose time is of too great value to admit of their perusing numerous pages in quest of a general idea.

THE PORTABLE ENCYCLOPÆDIA.

A.

A. This letter is placed first in the alphabet of every language with which we are acquainted, with the exception of the Ethiopic, in which it is the thirteenth. The reason of this is by some supposed to be the great simplicity of its sound. In the Continental, and in the Oriental languages, this letter maintains a greater uniformity than in the English language, in which it has three distinctly different sounds, besides a variety of occasional sounds. The three principal sounds are denominated, the broad, the open, and the slender, as heard in the words, wall, father, face. In grammar, it is styled the indefinite article, and denotes one, as a man. In music, A is the nominal of the sixth note in the gamut: also the name of one of the two natural moods, and the open note of the second string of the violin. In the kalendar, it is the first of the dominical letters: among logicians it denotes a universal affirmative proposition: as a numeral, A signified one among the Greeks; but among the Romans it denoted five hundred, and with a short horizontal line over it thus, Ā, five thousand. This letter is often used as an abbreviation. Thus A. A. stands for *Augusti*, A. A. A. for *aurum argentum æs*; and among chemists it signifies *amalgam*. In trials of criminal causes among the Romans, A signified *absolvo*, I acquit, and was hence named litera salutaris, a *saving letter*. When placed to bills of exchange in England it signifies accepted: A. M. stands for *anno mundi*, *in the year of the world*; also for *artium magister*, or *master of arts*; *ante meridiem*, or *before noon*; A. B. *bachelor of arts*: A. C. for *ante Christ*, [illegible]; A. D. fo *anno Domini*; A. A. U. C. for *anno ab urbe condita, the year from the building of Rome*. In physicians' prescriptions $\bar{a}$ or $\overline{a\ a}$ denotes *ana*, an equal weight or quantity of each.

AAM, or Haam, a liquid measure used by the Dutch, containing two hundred and eighty-eight pints English measure.

AB, in the Hebrew chronology, the eleventh month of the civil, and the fifth of the ecclesiastical year, containing thirty days, and comprehending the latter part of July, and the beginning of August.

ABACA, a kind of flax or hemp which grows in the Philippine Islands.

ABACK, a sea term, which signifies the state of the sails of a ship, when, from being full, they are instantly driven flat against the mast by the sudden shifting of the wind, or by a change in the ship's course.

ABACUS, in architecture, signifies the upper part of the capital of a column. In the Tuscan, Doric, and Ionic orders, it is flat and square; but in the other orders, viz. the Corinthian and Composite, its four sides are arched inwards, and embellished in the centre with an ornament, generally a rose, or some other flower. The invention is ascribed to Callima[illegible], who, seeing a small basket covered with [illegible]ile, placed over the root of an acanthus plant, which grew on the grave of a young lady, was so struck with the appearance, that he executed a capital in imitation of it; representing the tile by the abacus, the leaves of the acanthus by the volutes; and the basket by the body of the capital. In ancient architecture the term signifies certain compartments in Mosaic pavements.

Abacus, among ancient mathematicians, was a table strewed over with dust or sand, on which they drew their diagrams.

Abacus, in arithmetic, an instrument for facilitating calculations by means of counters also a table of numbers ready cast up.

Abacus *logisticus*, a kind of multiplication table in the form of a right-angled triangle, each side having the numbers from one to sixty, and the area the product of each two opposite numbers.

ABAFT, in sea language, signifies the situation of any thing placed towards the stern of the vessel; thus *abaft the beam*, is the situation of any object with the ship, when it is in that part of the horizon contained between a line at right angles with the keel, and that point of the compass directly opposite to the ship's course.

ABAGI, or Abasi, a silver coin current in Persia and Georgia, valued at about eighteenpence.

ABALIENATUS, a physical term which, when applied to any part of the body, denotes that it must be cut off; when applied to the senses, it denotes their total destruction.

ABASED, or Abaisse, in heraldry, a term descriptive of the wings of eagles, &c. when the tip inclines downwards to the point of the shield, or when the wings are shut.

ABATE, in law, signifies to break down, or destroy, as to abate a nuisance, and to abate a castle. It means to defeat, or overthrow, in consequence of some error or exception.

ABATEMENT, in heraldly, is an accidental figure added to a coat of arms, to lessen its true dignity, and to indicate some stain in the character of the bearer. In law, it signifies the rejecting a suit on account of some fault, either in the matter or proceeding; and in commerce, it has much the same signification as the term discount. In the excise, it means the usual allowance made in the duty on damaged goods.

ABATIS, in fortification, a term applied to the cutting down of entire trees, and placing them with the branches pointing towards the enemy, to impede their progress.

ABATOR, in law, is an intruder who enters on the possession of an estate to the hindrance of the lawful heir, keeping him out till he brings the writ *intrusione*.

ABB, among clothiers, means the yarn of a weaver's warp; the wool of which it is made is called *abb wool*.

ABBE, a term formerly applied in France to persons who were candidates for church preferment.

ABBESS, the superior of an abbey, or convent of nuns. An abbess exercises the same authority over nuns, that an abbot does over monks, spiritual functions alone excepted.

ABBOT, the superior or governor of an abbey. There are different orders of abbots known by the appellations, mitred, and not mitred, croziered, and not croziered, and œcumenical. The mitred abbots are those who wear the mitre, and exercise episcopal jurisdiction: the croziered are so named from their carrying the crozier, or pastoral staff: and the œcumenical abbots are such as exercise universal dominion. The title is also given to bishops whose sees were formerly abbeys: to the superiors of some congregations of regular canons, as that of St. Genevieve at Paris, and the chief magistrate of the Genoese republic formerly bore the title of abbot of the people.

ABBREVIATION, the contracting of a word or sentence, by omitting some of the letters, or by substituting certain marks or characters in their place. Abbreviations of this sort are used chiefly by lawyers, physicians, and chemists, but most extensively by the Jewish rabbins in their writings.

ABBREVIATORS, a college of seventy two persons in the chancery of Rome, whose business is to prepare the pope's briefs, and reduce his grants in proper form.

ABECEDARY, or Abecedarian, a term sometimes given to schoolmasters, but properly to compositions, the different parts of which are disposed in the order of the letters of the alphabet. This method of writing is chiefly in use among Hebrew writers; and as the Hebrew alphabet consists of twenty-two letters, poems of this kind have only twenty-two lines or systems of lines, or periods; and each line, or period of lines begins with each letter in its order. The following portions of Scripture are specimens of this kind of composition, Ps. cxi. cxii. cxix. Lam: iii.

ABDICATION, the relinquishment of a public office before the term of service is expired. It differs from resignation in this respect, viz. that the latter is done in favour of some other person, whereas the former is done without any such view. Thus Dioclesian abdicated the throne, but Philip IV. of Spain resigned it.

ABDOMEN, the lower part of the trunk of the body, reaching from the thorax to the bottom of the pelvis.

ABDOMINALES, in natural history, an order of fishes having ventral fins placed behind the pectoral in the abdomen, and the branchia ossiculated.

ABDUCTION, in logic, is a form of reasoning called by the Greek *apogogue*, in which the greater extreme is contained in the medium, but the medium not in the lesser extreme. Ex.: whatever God has revealed is certainly true: now God has revealed a future retribution, therefore a future retribution is certainly true. In the use of this kind of reasoning, the minor proposition must be proved to be contained in the major, otherwise the reasoning is inconclusive.

ABDUCTOR, in anatomy, a name given to certain muscles, from their serving to contract or open the parts to which they belong.

ABERRATION, in astronomy, a small apparent motion in the fixed stars, discovered by Mr. Molyneaux, and Dr. Bradley in the year 1725. By the observations of the latter, this phenomenon has been ascertained to arise from the motion of light, combined with the annual motion of the earth in its orbit. The aberration of a planet is equal to its geocentric motion, or that space in which it moves during the passage of light from the planet to the earth.

ABERRATION, in optics, a deviation of the rays of light, when inflected by a lens or speculum, by which they are prevented from meeting in the same point. Aberrations are of two kinds, one proceeds from the figure of the glass or speculum, the other from an inequality in the refrangibility of the rays themselves. This last is called the Newtonian aberration, from the name of the discoverer.

ABETTOR, a term in law, implying one who instigates another to commit a crime. It is the same as the term *art and part* in the law of Scotland.

ABEYANCE, or Abeiance, or Abayance, in law, signifies the expectancy of an estate or possession.

ABJURATION, in law, is a declaration on oath that the pretender, or son of James II. and his issue, have no right to the throne of these kingdoms.

ABLATIVE, in Latin grammar, the name given to the sixth case of nouns; the word is formed from the verb *auferre*, and signifies to take away; it is called by Priscian the *comparative case*, as serving among the Latins for comparing as well as taking away. *Ablative absolute*, is so called because governed by no other word in the sentence.

ABLEGMINA, in Roman antiquity, signify

the chosen parts of the sacrifice, which were always offered to the gods.

ABLUENTS, diluting medicines, or such as dissolve and carry off acrimonious matter from the stomach and intestines.

ABLUTION, a religious ceremony still used in eastern countries, consisting in washing the body before public festivals, or entering the temples. In the Church of Rome the term is applied to the water, with which the priest washes his hands, after consecrating the host: and among chemists it signifies the washing away the superfluous salts of any body.

ABOLITION, in law, denotes the repealing of any law or statute, or prohibiting any custom, ceremony, &c.

ABOLLA, a kind of military garment, worn by the Greek and Roman soldiers, to keep out the cold.

ABOMASUS, ABOMASUM, or ABOMASIUS, in comparative anatomy, names used to designate the fourth stomach of ruminating animals.

ABORTION, in medicine, signifies an untimely or premature birth of a foetus, otherwise called a miscarriage. See MIDWIFERY.

ABOUT, a sea term, signifying the situation of a ship immediately after she has changed her course; in military tactics, it signifies a change in the position of a body of troops.

ABRA, a Polish silver coin of about the value of one shilling.

ABRAUM, a kind of red clay used by cabinet-makers to deepen the colour of new mahogany; it is found in the Isle of Wight, and is sometimes called Adam's earth, from its colour.

ABREAST, a sea term, expressing the situation of two or more ships that lie with their sides parallel to each other; and their heads advanced.

ABRIDGING, in Algebra, is the reducing of a compound equation to a more simple form. See ALGEBRA.

ABRIDGMENT, in literature, signifies much the same thing as an epitome of a large work. The excellence of an abridgment lies in taking only what is material and substantial, and rejecting what is superfluous either in sentiment or style. In law, it is the shortening of a count or declaration.

ABROMA, in botany, a word signifying *not fit for food*, is used to designate a genus of plants of the class and order of polyadelphia dodecandria. There are only two known species, viz. the maple-leaved abroma, which is a tree with a straight trunk, yielding a gum when cut, and filled with a white pith, and is a native of New South Wales, and the Philippine Islands: the other is Wheler's abroma; it is a native of the East Indies, and unknown in Europe.

ABSCESS, in medicine and surgery, an inflammatory tumour containing purulent matter; it is synonymous with apostem, imposthume, and imposthumation, and is the consequence of inflammation.

ABSCISSE, in conic sections, the part of the diameter of a curve line intercepted between the vertex of that diameter and the point where any ordinate or semi-ordinate of that diameter falls. Hence there are numerous abscisses in the same curve, and also numerous ordinates. In the parabola, one ordinate has but one abscisse: in the ellipses it has two; in a hyperbola consisting of two parts it has also two; and in curves of the second and third order, it may have three and four. See CONIC SECTIONS.

ABSCISSION, in rhetoric, a figure of speech by which the orator breaks off suddenly, in the middle of his discourse, to make the deeper impression on his audience.

ABSINTHIUM. See ARTEMISIA.

ABSOLUTE NUMBER, is the known quantity which possesses one side of an equation; thus in $x^2+12x=24$, the absolute number is 24, which is equal to the square of x added to 12 x.

ABSOLUTE EQUATION, in astronomy, the sum of the optic and eccentric equations. The optic equation is the apparent inequality of the motion of a planet; and the eccentric inequality proceeds from the uniformity of the planet's motion.

ABSOLUTION, in civil law, is a sentence whereby the party accused is declared innocent of the crime laid to his charge, and re-[illegible] from all further proceedings. In divi-[illegible] it means the forgiveness of sins, which [illegible]er the Church of Rome claims for the priest; but the Protestants deny it, making their form of absolution merely declaratory.

ABSORBENTS, in the materia medica, are certain medicines that have the power of drying up redundant humours, whether applied to ulcers, or taken inwardly.

ABSORBENT VESSELS, in anatomy, a term applied indiscriminately to the lacteals, the lymphatics, and the inhalent arteries. In botany, it is applied to the fibres of the roots of plants, because they attract and imbibe the nutricious juices from the earth.

ABSORPTION, in chemistry, signifies the conversion of a gaseous fluid into a liquid or solid on being united with some other solid.

ABSTERGENTS, medicines proper for cleansing the body from concretions and other impurities, not to be effected by simple abluents.

ABSTRACT IDEA, among logicians, the idea of some general quality or property considered simply in itself, without any respect to a particular subject. The term is applied to other things to denote their purity or universality. Thus pure, or abstract mathematics, refer to magnitude or quantity, without application to particular objects.

ABSTRACTION, in chemistry, is applied to the process of distillation, in which the volatile products that come over, and are condensed in the receivers, are said to be abstracted from the more fixed parts that remain behind.

ABYSS, a term used to denote, in general any thing profound, or, as the word itself imports, bottomless. In scripture, it is used to denote the deepest parts of the sea, from their being unfathomable; and, in a figurative sense, it signifies the state of the dead, *hell*, or the bottomless pit.

ACACIA, in botany, a name improperly given to several plants as Guilandia, Guiacum, Mimosa, Poincena, and Spartium, which see. In the ancient materia medica, it signified a gum made from the acacia tree, and is supposed to have been the same with our gum-arabic.

ACACIA GERMANICA, a juice made from wild sloes before they become fully ripe; it is moderately astringent, and is given in fluxes and hemorrhages.

ACACIA, or AKAKIA, a roll or bag, represented on the medals of the Greek and Roman emperors, the exact import of which is not known; some supposing it to represent a handkerchief, for giving signals at the public games, others a roll of memoranda, and others bag of earth, to indicate mortality.

ACADEMICS, a term particularly applied by writers to a sect of ancient philosophers, the followers of Socrates and Plato, the distinguishing characteristic of whose system was the uncertainty and incomprehensibility of truth. They have been called sceptics, and, certainly, if the term is applicable to any class of men, it was to them, since they carried their theory so far as to make both extremes meet, by doubting whether they ought to doubt!

ACADEMY, originally signified a place near Athens, surrounded with high trees, and adorned with covered walks, belonging to a person of the name of Academus, or Ecad[illegible] In this place Plato opened his school of philosophy; and, from this circumstance, the term is applied in modern times to all societies, established for the improvement of the arts and sciences.

ACÆNA, in botany, a genus of the tetrandria monogynia class and order of plants. It grows in Mexico, and is about two feet high.

ACALYPHA, or THREE SEEDED MERCURY, in botany, a genus of the monecia monodelphia class. There are fourteen species of it; some annual, and some shrubs; but the plants, having no beauty to recommend them, are not cultivated, and are preserved only in some botanic gardens.

ACHANACEOUS *Plants*, those which are prickly, and bear their flowers and seeds on a kind of head.

ACANTHA, in botany, the prickles of a thorny plant: in zoology, the spines of certain fishes, as the echinus marinus, &c.

ACANTHUS, *Bear's Breech*, in botany, a genus of the didynamia, angiospermia class, and belonging to the natural order of personatæ. Of this plant there are about ten species. In architecture, *acanthus* is an ornament representing the leaves of the herb acanthus, and used in the capitals of the Corinthian and composite orders. See ABACUS.

ACARUS, the tick or mite, a genus of insects of the order of aptera, or those without wings. The acarus is oviparous, and has eight legs; two eyes, one on each side of the head; and two jointed tentacula. It is extremely prolific, and, though voracious, is said to live many months without food. According to Gmelin there are eighty-two species of this insect.

ACATALECTIC, a term in ancient poetry, applicable to such verses as have all their feet and syllables without any defect at the end; those which are not so are called *catalectic*.

ACAULOSE, or ACAULOUS, in botany, a term applied to plants that have no stem.

ACCELERATION, in mechanics, denotes the augmentation or increase of motion in accelerated bodies.

The term acceleration is chiefly used in speaking of falling bodies, or the tendency of heavy bodies towards the centre of the earth produced by the power of gravity; which, acting constantly and uniformly upon them, they must necessarily acquire every instant a new increase of motion.' See GRAVITATION.

ACCELERATOR. See ANATOMY.

ACCENT, among grammarians, is the raising or lowering of the voice in pronouncing certain syllables of words.

We have three kinds of accents, viz. the acute, the grave, and circumflex. The acute accent, marked thus (´), shews that the voice is to be raised in pronouncing the syllables over which it is placed. The grave accent is marked thus (`), and points out when the voice ought to be lowered. The circumflex accent is compounded of the other two, and marked thus (˜ or ˆ): it denotes a quavering of the voice between high and low. Some call the long and short quantities of syllables, accents; but erroneously.

ACCEPTANCE, in common law, is the tacitly agreeing to some act before done by another, which might have been defeated but for such acceptance.

ACCEPTANCE, among merchants, is the signing or subscribing a bill of exchange, by which the acceptor obliges himself to pay the contents of the bill. Bills payable at sight are not accepted, because they must either be paid on being presented, or protested for want of payment.

ACCESSARY, or ACCESSORY, in common law, one who is guilty of a felonious offence, not principally, but by participation. There are two kinds of accessaries; before the fact, and after it. The first is he who commands or procures another to commit felony, and is not present himself: the second is he who receives, assists or comforts any man who has done murder, or felony, whereof he has knowledge. In the lowest and highest offences there are no accessaries, but all are considered as principals.

ACCIACATURA, is a term in music, which denotes the putting down with any interval the half note below it, and instantly taking off the finger which has struck the lowest of the two notes, continuing the sound of the other note till the harmony is changed.

ACCIDENT, denotes in a general sense, any casual event. Among logicians, it signifies, 1. whatever does not essentially belong to a thing; 2. such properties in any subject as are not essential to it; 3. in opposition to substance, all qualities whatever are called accidents; as sweetness, softness, hardness, &c.

In grammar, accident implies, a property attached to a word without entering into its essential definition.

In heraldry it signifies, an additional note or mark in a coat of arms, that may be either omitted or retained without altering the essence of the armour.

ACCIDENTAL, in a general sense, signifies what happens by accident, or that is not essential to its subject. In philosophy it is applied to that effect which flows from some cause intervening by accident, without having the appearance of being subject to general laws.

ACCIDENTAL *point*, in perspective, is that point in the horizontal line where the projections of two lines, parallel to each other, meet the perspective plane

ACCIDENTAL *colours*, are those which depend

on the affections of the eye, in contradistinction to those that belong to the light itself.

ACCIPENSER, in ichthyology, a genus of fishes, belonging to the order of nantes, and class of amphibia, in the Linnæan system. The accipenser has a single linear nostril: the mouth is in the under part of the head, and contains no teeth; the cirri are below the snout, and before the mouth. There are three species of this genus, viz. 1. ACCIPENSER HUSO, with naked body, and four cirri; the skin is so tough as to be made into tackle for drawing carts, and other carriages; and the isinglass of the shops is made from its sounds. The Huso is the largest of the genus, and is found in the Danube, and in some of the rivers of Russia. 2. ACCIPENSER RUTHENUS, has four cirri, and is a native of Russia 3. ACCIPENSER STURIO, or the sturgeon, has four cirri, it annually ascends our rivers, but in no great numbers, and is taken by accident in the salmon-nets. It is found chiefly in the rivers of America, and in the Baltic. Cavier is made of the roes of this fish, and also of the other sorts of sturgeons dried, salted, and packed up close. The sturgeon grows to a great size, and is found sometimes to weigh 500 pounds.

ACCIPITRES, the name of a whole order of birds, the distinguishing characteristic of which is, that they have a hooked or crooked beak.

This order comprehends four genera, viz. the vulture, falco, strix, and lanius kinds; and seventy-two species.

ACCLAMATION, in Roman antiquity, a shout raised by the people to testify their applause, or approbation of their princes, generals, &c. Such is that of Ovid, Fast. 1 613. *Augeat imperium nostri ducis, augeat annos.*

The acclamations of the theatres, which were at first confused and tumultuous shouts, became in process of time a kind of regular concerts. When Nero played in the theatre, a signal was given, and, upon this, 5000 soldiers began to c[illegible]t his praise, which the spectators were obliged to repeat.

ACCOMPANIMENT, in heraldry, denotes any thing added to a shield by way of ornament, as the belt, mantling, supporters, &c.

Accompaniment is also used for several bearings about a principal one, as a saltier, bend, fess, &c.

ACCOMPLICE, in law, a person who is privy to, or aiding in, the perpetration of some crime. See ACCESSARY.

ACCOUNT, or ACCOMPT, in a general sense, is used for all arithmetical computations, whether of time, weight, measure, money, &c. Account is also used collectively, for the books in which merchants, traders, and bankers, enter all their business, traffic, and bargains with each other. See BOOK-KEEPING.

ACCOUNTANT *General*, in the court of chancery, an officer appointed by act of parliament to receive all monies lodged in court, and convey the same to the bank of England, for better security. The salary of this officer and his clerks is to be paid out of the interest made of part of the money; it not being allowable to take fees in this office.

ACCRETION, in natural history, the increase or growth of a body by an external addition of new parts, thus it is salts, shells, stones, &c. are formed.

ACCROCHE', in heraldry, denotes a thing being hooked into another.

ACER, *maple*, in botany, a genus of the monoecia order and polygamia class of plants, and belonging to the natural order of trihilata. There are 25 species. See MAPLE.

ACETATES, in chemistry, a genus of salts formed by the acetic acid. They may be distinguished by the following properties: they are decomposed by heat; the acid being partly driven off, partly destroyed:—they are very soluble in water:—when mixed with sulphuric acid, and distilled in a moderate heat, acetic acid is disengaged:—when they are dissolved in water, and exposed to the open air, their acid is gradually decomposed.

ACETIC *Acid*, is the same which, in a very dilute and somewhat impure state, is called vinegar. In the juice of many plants it is found combined with pot-ash, particularly the sambucus nigra, phœnix dactilifera, galium verum. Sweat, urine, and even fresh milk contain it. The varieties of this acid are four. 1. Wine vinegar; 2. Malt vinegar; 3. Sugar vinegar; 4. Wood vinegar.

ACHANIA, a genus of the monodelphia polyandria class, and the natural order of columniferæ. The essential character is, calyx double; outer many-leaved; corolla convolute; berry five-seeded.

The achania genus includes three species, all exotics, and cultivated (chiefly from cuttings) as stove plants.

ACHILLEA, a genus of plants comprehending the millefolium and patarmica of Tournefort. There are twenty-seven species, only two of which are natives of Britain. It is used in medicine as a sternutatory. A beautiful double variety is cultivated in our gardens, under the name of white bachelor's buttons. The other English milfoil is the yarrow, well known in our meadows.

ACHROMATIC, an epithet expressing a want of colour, introduced into astronomy by De la Lande.

ACHROMATIC. *Telescopes*, formed of a combination of lenses, which in a great measure, correct the optical aberration arising from the various colours of light, are called achromatic telescopes. Some of these have been made wonderfully perfect, and their excellence appears to be limited only by the imperfections of the art of glass-making. The artifice of this capital invention of Dollond consists in selecting, by trial, two such pieces of glass, to form the object lenses, as separate the variously coloured rays of light to equal angles of divergence, at different angles of refraction of the mean ray; in which case it is evident, that, if they be made to refract towards contrary parts, the whole ray may be caused to deviate from its course, without being separated into colours. The difficulty of the glass-maker is in a great measure confined to the problem of making that kind of glass which shall cause a great divergence of the coloured rays with respect to each other, while the mean refraction is small. See OPTICS, and TELESCOPE.

ACHYRANTHES, in botany, a genus of the pentandria monogynia class of plants, belonging to the natural order of miscellaneæ. There are eleven species, but they have but little beauty, and are only preserved in botanic gardens.

ACIA, in botany, a genus of the monadelphia dodecandria class and order: calyx five-parted, five petals, drupe dry, coriaceous, fibrous, one-seeded. Two species, tree sixty feet high, found in Guiana.

ACICULÆ, certain small spikes or prickles, in the form of needles, with which nature has armed several animals, as the hedgehog, the echinus marinus, &c.

ACID, in chemistry, a term originally synonymous with *sour*, and applied only to bodies distinguished by that taste; but it now comprehends under it all substances possessed of the following properties. Acids, when applied to the tongue, excite the sensation of sourness; they change the blue colours of vegetables to a red; they unite with water in almost any proportion; they combine with all the alkalis, and most of the metallic oxides and earths, and form with them those compounds called, in chemistry, salts. Every acid does not possess all these properties, but they all possess a sufficient number to distinguish them from other substances. See CHEMISTRY.

ACIDIFIABLE, capable of being converted into an acid by an acidifying principle. Substances possessing this property are called *radicals*, or acidifiable bases.

ACIDIFIABLE *base*, or RADICAL, is any substance, whether simple or compound, that is capable of uniting without decomposition, with such a quantity of oxygen as to become possessed of acid properties. Almost all the acids agree with each other in containing oxygen, but they differ in their radicals; of course the acidifiable base, or radical, determines the species of acid.

ACIDOTUM, a genus of the monoecia polyandria class and order. The essential character is: male, calyx five-leaved; corolla none; stamina fixed to a globular receptacle. Female, calyx six-leaved; corolla none; style trifid; capsule three-grained. One species only is noted of this plant, which is a native of Jamaica.

ACINUS, a name given to grapes or berries growing in clusters, in opposition to baccæ, or such berries as grow single.

ACLIDES, in Roman antiquity, a kind of missive weapon, with a thong fixed to it, whereby it might be drawn back again.

Most authors describe the aclides as a sort of dart or javelin; but Scaliger makes it roundish, or globular, with a wooden stem to poise it by.

ACNIDA, Virginian hemp, in botany, a genus of the pentandria pentagynia class and order. There is but a single species, viz. A. cannabina, which is a native of Virginia, and some other parts of America; it is seldom cultivated in Europe.

ACONITUM, wolfs-bane, or monk's-hood, a genus of plants of the class and order polyandria trigynia. The essential character is, calyx none; petals five, the highest arched; nectaries two, peduncled, recurved; capsules three or five. There are nine species of this genus, all perennials. It takes its name from its flower resembling in some measure, a man's head with a helmet or hood on it.

ACORUS, in botany, the sweet flag, or sweet rush, a genus of the monogynia order, and hexandria class of plants, and belonging to the natural order of piperitæ. There are two species; the A. calamus grows naturally in shallow standing waters, and is found wild in rivulets and marshy places about Norwich. It is carminative, and stomachic, having a warm, pungent taste, and is frequently used as an ingredient in bitters.

ACORUS, a blue coral, found on the coasts of Africa, from Rio del Re, to the river Camarones. It grows in form of a tree, on a rocky bottom.

ACOUSTICS, is that branch of science which treats of the nature and various modifications of sound. See PNEUMATICS.

ACOUSTIC *Duct*, in anatomy, is the name given to the external passage of the ear. See ANATOMY.

ACQUITTAL, in law, is a deliverance or setting free from the suspicion of guilt; acquittal is either in fact or in law; in fact, it is where a person, on the verdict of a jury, is found not guilty; in law, it is when two persons are indicted, one as a principal, and, the other as accessary: here if the former be discharged, the latter, of consequence, is acquitted.

ACQUITTANCE, a written discharge for a sum of money that has been paid. A man is obliged to give an acquittance on receiving money; and a servant's acquittance on behalf of his master is binding, if that servant used to receive his master's rents.

ACRE, a measure of land containing four square roods, or one hundred and sixty square poles.

The *arpent*, or French acre, is equal to one and a quarter of the English acre. That of Strasburgh is only about one half of the English acre. The Scotch acre is to the English acre, by statute, as 100,000 to 78,694.

We have computations of the number of acres contained in several countries, thus England is said to contain forty-six millions and upwards, and the United Provinces about four and one-third millions.

ACRE-*tax*, a tax levied upon lands, at a certain rate by the acre, otherwise called acre-shot.

ACRID, an appellation given to such matter as is of a sharp and pungent taste.

Ancient naturalists distinguished two kinds of acrid tastes; one proceeding from hot and dry, as in pepper; the other from hot and moist, as in garlic.

ACRIDÆ, in entomology, the name by which Linnæus has distinguished the first family of the gryllus, or the cricket, properly so called: the characters of which are, that the head is conical and longer than the thorax, and the antennæ ensiform, or sword-shaped. Of this family there are eight species, none of which are found in Britain. The insects of this family feed on other insects. See GRYLLUS.

ACROATIC, in the Aristotelian schools, a denomination given to such lectures as were calculated only for the intimate friends and disciples of that philosopher, being chiefly employed in demonstrating some speculative, or abstruse part of philosophy.

ACROBATICA, or ACROBATICUM, in Grecian antiquity, an engine on which people were raised aloft, that they might have the better prospect.

ACROCHORDUS, in natural history, a genus of the class amphibia, and of the order serpents. There are but three species, viz.

A. javanicus, warted snake, brown, beneath paler; the sides obscurely variegated with white. It inhabits Java, chiefly among the pepper plantations; grows sometimes to seven feet long. The warts, by means of a magnifying glass, appear to be convex carinate scales, and the smaller ones are furnished with two smaller prominences, one each side the larger. A. dubius, which very nearly resembles the javanicus, except that the head is covered with very minute, rough, and warted scales, differing in size alone from those on the other part of the animal. A. fasciatus, resembles the dubius so much, that some naturalists suppose them both to be of the same species, and differing only in age and cast of colours.

ACRONICHAL, or Achronycal, in astronomy, an appellation given to the rising of a star above the horizon, at sunset; or to its setting, when the sun rises. Acronichal is one of the three poetical risings of a star; the other two being called cosmical and helical.

ACROSTIC, in poetry, a kind of poetical composition disposed in such a manner, that the initial letters of the verse make some person's name, title, motto, &c.

ACROSTICUM, *rusty-back*, *wall-rue*, or *forked fern*, in botany, a genus of the cryptogamia filices; the character of which is, that the fructifications cover the whole inferior surface of the leaf. There are forty-five species distributed into different classes. Few of the species have been introduced into gardens.

ACT, among logicians, denotes an operation of the human mind; in which sense comprehending, judging, willing, &c. are called acts.

Act, among lawyers, denotes an instrument or deed in writing, to prove the truth of some transaction.

Act, in the *universities*, is a thesis maintained in public by a candidate for a degree. The term when masters or doctors complete their degree is called the act, which is held with great solemnity.

Acts of parliament are called statutes; acts of the Royal Society, transactions; those of the French Academy of Sciences, memoirs; those of the Academy of Sciences at St.Petersburg, commentaries.

ACTÆA, or herb Christopher, a genus of the polyandria monogynia class and order. The essential character is, calyx four-leaved; corolla four-petalled; berry one-celled; seeds semi-orbicular, in two rows. There are four known species of this genus: viz. the spicata; racemosa; japonica; and aspera. The racemosa, or black snake root, found in America, is said to afford an antidote against the bite of the rattle-snake. The leaves of the aspera are used by the Chinese in polishing their tin ware.

ACTINIA, in natural history, a genus of the mollusca order of worms; the characters of which are, body oblong, cylindrical, fleshy, contractile, fixed by the base; mouth terminal, expansile, surrounded with numerous cirri, and without any aperture. There are thirty-six species. These marine animals are viviparous, and have no aperture but the mouth.

ACTION, in mechanics and physics, is the pressure or percussion of one body against another.

It is one of the laws of nature, that action and re-action are equal, that is, the resistance of the body moved is always equal to the force communicated to it; or which is the same thing, the moving body loses as much of its force, as it communicates to the body moved.

Action, in rhetoric, may be defined the accommodation of the voice, but more especially the gesture, of an orator, to the subject he is upon. It is chiefly directed to the passions of the audience.

Action, in law, signifies a demand made before a judge for obtaining what we are legally intitled to demand, and is more commonly known by the name of *law suit*, *process*.

In physiology, action is applied to the functions of the body, whether vital, animal, or natural.

ACTIVE, denotes something which communicates action or motion to another; in which acceptation it is opposed to passive.

ACTOR, in general, signifies a person who acts or performs something, the term is chiefly applied to the person who performs a part in the drama.

ACULEATE, or Aculeated, an appellation given to any thing that has aculei, or prickles: thus fishes are divided into those with aculeated and not aculeated fins.

ACUPUNCTURATION, a name given to a surgical operation in use among the Chinese and Japanese, which is performed by thrusting the point of a gold or silver needle to a certain depth in the part affected. It is chiefly employed in head-aches, convulsions, lethargies, &c.

AD, a Latin preposition, expressing the relation of one thing to another.

It is frequently prefixed to other words thus,

Ad *bestias*, in antiquity, a kind of punishment, which consisted in throwing the criminal to wild beasts.

Ad *hominem*, among logicians, an argument drawn from the professed belief or principles of those with whom we argue.

Ad *libitum*, at discretion; in music, the same with piace, or si piace.

Ad *ludos*, in Roman antiquity, a kind of punishment, whereby the criminals entertained the people, either by fighting with wild beasts, or with each other.

Ad *metella*, in Roman antiquity, the punishment of such criminals as were condemned to the mines, and therefore called metallici. A piece of excellent policy, thus to make the punishment of rogues doubly subservient to the good of the commonwealth.

Ad *valorem*, among the officers of the king's revenue, a term used for such duties, or customs, as are paid according to the value of the goods sworn to by the owner.

ADACTED, in military affairs, is a term applied to stakes or piles, driven into the earth by large malls shod with iron, as in securing ramparts or pontoons.

ADAGIO, softly, leisurely; in music, a term used to denote the slowest of all times, the grave only excepted. Sometimes it is repeated, adagio adagio, to signify a still greater retardation of time.

ADAMANT. See Diamond.

ADAMANTINE *Spar*. This stone, which comes to us from the peninsula of Hither India, and also from China, has not engaged the attention of the chemical world till within a few years past. It is remarkable for its extreme

hardness, which approaches to that of the diamond, and by virtue of which property it is used for polishing gems.

ADANSONIA, in botany, a genus of the monadelphia order, and polyandria class, named after Michael Adanson, an indefatigable French naturalist. The A. digitata, Ethiopean sour-gourd, or monkies' bread, called also abavo, is the only species known of this genus.

ADDER. See Coluber.

ADDITION, in arithmetic, the first of the four fundamental rules of that art, whereby we find a sum equal to several smaller ones.

Addition, in heraldry, something added to a coat of arms, as a mark of distinction or honour, and, therefore, directly opposed to abatement.

Additions, in law, denote all manner of designations given to a man, over and above his proper name and surname, to shew of what estate, degree, mystery, place of abode, &c. he is.

ADDUCTOR, in anatomy, a general name for all such muscles as serve to draw one part of the body towards another. See Anatomy.

ADELIA, in botany, a genus of the dioecia gynandria class and order. Male: calyx three parted; no corolla; stamina numerous; united at the base. Female: calyx five-parted; no corolla; styles three, lacerated. Capsule three-grained.

ADENANTHERA, in botany, a genus of the decandria monogynia class of plants, the calyx of which is a single-leaved perianthium, very small, and cut into five segments: the corolla consists of five lanceolated bell-shaped petals; the fruit is a long membranaceous compressed pod, containing several round seeds.

The seeds are very beautiful, and are used by jewellers as weights, being each of them four grains.

ADFECTED *equations*, in algebra, those wherein the unknown quantity is found in two or more different powers · such is $x^3 - ax^2 + bx = a^2b$.

ADHESION, in philosophy and chemistry, is a term generally made use of to express the property which certain bodies have of attracting to themselves other bodies, or the force by which they adhere together: thus, water adheres to the finger, mercury to gold, &c. Hence arises an important distinction between two words, that in a loose and popular sense are often confounded. Adhesion denotes a union to a certain point between two dissimilar substances, and cohesion that which retains together the component particles of the same mass.

ADIANTHUM, *Maidenhair*, in botany, the name of a genus of plants of the cryptogamia filices class and order, the characters of which are, that the fructifications are collected in oval spots at the ends of the leaves, which are folded back. There are forty-four species, of which one only belongs to Great Britain, viz. the A. capillis veneris, which is found, though rarely, in Scotland and Wales, on rocks and moist walls, and which is a native of the south of Europe and the Levant. From this the syrup of capillaire is made

ADIPOCIRE, or Adipocere, a term applied by chemists to a substance which is formed from animal matter during the changes which it undergoes in its progress towards total decomposition. This matter, says Dr. Ure, very considerably resembles spermaceti. Immense masses of it were found on the removal of the bodies from the burying ground des Innocens, at Paris, 1786 and 1787. Several interesting experiments were made on this substance by Fourcroy, at the time of this discovery, the results of which he laid before the Royal Academy of Sciences, in a memoir which he read in 1789. This memoir is exceedingly interesting; the substance of it is ably detailed in Dr. Ure's Chemical Dictionary, second edition, p. 116.

ADJUTAGE, or Ajutage, in hydraulics, the tube fitted to the mouth of a jet d'eau.

It is through the adjutage that water is played, and directed into any desired figure; so that the great diversity of fountains consists chiefly in the different structure of their adjutages.

ADJUTANT, in the military art, an officer whose business it is to assist the major, and on that account he is sometimes called the aid major.

Adjutant *General*, an officer of distinction, who assists the general in his duty; forms the several details of the duty of the army; and keeps an account of the state of each brigade and regiment. In the day of battle he sees the infantry drawn up: after which he places him[illegible]y the side of the general to receive his

ADMEASUREMENT, in law, a writ for adjusting the shares of something to be divided. Thus, admeasurement of dower takes place, when the widow of the deceased claims more as her dower than what of right belongs to her. And, admeasurement of pasture may be obtained, when any of the persons who have right in a common pasture puts more cattle to feed on it than he ought.

ADMINISTRATOR, in law, the person to whom the goods, effects, or estate of one who died intestate are entrusted; for which he is to be accountable, when required.

ADMIRAL, in maritime affairs, a great officer, who commands the naval forces of a kingdom or state, and decides all maritime causes. For the latter purposes a commissioner has been instituted in England, who, by a statute of W. and M. has the same authority as the Lord High Admiral. The admirals of England are merely naval commanders. Every other business relative to the navy at large is directed by the Lords Commissioners of the Admiralty

ADMIRALTY, properly signifies the office of the Lord High Admiral, whether discharged by one or several joint commissioners, called Lords of the Admiralty.

Admiralty-*Court*, or Court of Admiralty, in the British polity, a sovereign court, held by the Lord High Admiral, or the Commissioners of the Admiralty.

ADMONITIO *fustium*, among the Romans, a military punishment, not unlike our whipping, only that it was performed with vine-branches.

ADONIS *flos*, a genus of plants, called in English pheasant's-eye. It is of the class and order polyandria polygynia: and the essential character is calyx five-leaved; petals, five or more, without a nectary; seeds naked.

The genus includes six species, much resembling the anemone in appearance, only smaller. The adonis autumnalis, an annual plant, is common in our gardens, and even in the field.

about London Its flowers are of a bright scarlet, with a black spot or eye at the bottom. The adonis vernalis is also cultivated in our gardens; but though a native of Switzerland and Germany, we have observed that it is somewhat tender; probably from its shooting so early in the spring: it has a large yellow flower.

ADOPTION, a solemn act whereby one made another his heir, investing him with all the rights and privileges of a son. This practice was frequent among the Greeks and Romans, and is still in use in India and Turkey.

ADORATION, from *ad* to, and *oris* the mouth, denotes the act of worshipping the Supreme Being. This was anciently done by prostrating the body with the face to the earth, as a gesture naturally flowing from the deepest humility of mind; the concealment of the face as the index to the interior operations of the mind, being strongly and most appropriately expressive of the worshipper's total unworthiness so much as to lift up his eyes before the great object of his worship.

ADOXA, in botany, a genus of the octandria tetragynia class of plants, the corolla of which is plain, and consists of a single petal, divided into four oval acute segments. There is but one species, the moschatellina, which is found growing naturally in shady place[illegible]d in woods: the flowers smell like musk.

ADRIFT, in naval affairs, the state of a vessel broken loose from her moorings, and driven to and fro by the winds or waves.

ADSTRICTION, among physicians, is used to denote the too great rigidity and closeness of the emunctories of the body, particularly the pores of the skin; also for the styptic quality of medicines.

ADVANCE, in the mercantile style, denotes money paid before goods are delivered, work done, or business performed.

Advanced-*guard*, or *Vanguard*, in the art of war, denotes the first line or division of an army, ranged or marching in order of battle; or it is that part which is next the enemy, and marches first towards them.

Advanced-*guard* is more particularly used for a small party of horse stationed before the main-guard.

ADVENTURE, *bill of*, among merchants, is a writing signed by a merchant, testifying that the goods mentioned in it to be shipped on board a certain vessel, belong to another per- who is to run all hazards: the merchant only obliging himself to account to him for the produce of them, be it what it will.

ADVENTURER, in a general sense, denotes one who hazards something. By statute 13. Geo. II. c. 4, adventurers may obtain a charter for whatever settlements in America they shall take from the enemy.

ADVERB, in grammar, a word joined to verbs, expressing the manner, time, &c. of an action: thus, in the phrase, *it is conducive to health to rise early*, the word *early* is an ad[illegible]b; and so of others.

ADVERSARIA is more particularly used among men of letters, for a kind of commonplace book, wherein they enter whatever occurs to them worthy of notice, whether in reading or conversation, in the order in which it occurs: a method which Morhof prefers to that of digesting them under certain heads.

ADVERTISEMENT is particularly used for a brief account of an affair inserted in the daily or other public papers, for the information of all concerned, or who may find some advantage from it. By the statute law, the penalty of 50*l.* is inflicted on persons advertising a reward, with "*no questions to be asked*," for the return of things lost or stolen. The same penalty attaches to the printer.

ADUMBRATION, in heraldry, denotes the shadow of any beast or charge outlined, and painted of a darker colour than the field.

ADVOCATE, *advocatus*, among the Romans, a person who undertook the defence of causes, which he pleaded much in the same manner as our barristers do at present.

Advocate, *Lord*, one of the officers of state in Scotland, who pleads in all causes of the crown, or wherein the king is concerned.

The lord advocate sometimes happens to be one of the lords of session; in which case, he only pleads in the king's causes.

ÆDES, in Roman antiquity, signified an inferior kind of temple, consecrated indeed to some deity, but not by the augurs. There were a vast number of these in ancient Rome; thus we read of the *ædes fortunæ, ædes pacis, ædes Herculis*, &c.

ÆDILE, in Roman antiquity, a magistrate whose chief business was to superintend buildings of all kinds, but more especially public buildings; as temples, aqueducts, bridges, &c.

ÆGICERAS, a genus of the class and order of the pentandria monogynia. The essential character is, calyx bell-shaped, half five-cleft, capsule bow-shaped, one-celled, gaping on the convex side; seed inverted. It is found in the Molucca islands, and in Ceylon. There are two species, the majus and minus.

ÆGILOPS, *goat's face*, in botany, a genus of the triandria digynia class and order, and of the natural order of the grasses. There are six species of this grass; all of them seem to be annual. They grow in the south of Europe.

ÆGIPHILA, *goat's friend*, a genus of the tetrandria monogynia class and order, and of the natural order of vitices. There are seven species, natives of the West Indies, chiefly of Jamaica.

ÆGIS, in heathen mythology, is particularly used for the shield, or, according to some, for the cuirass of Jupiter and Minerva.

ÆGLE, in botany, a genus of the polyandria monogynia class and order: calyx five-lobed; petals five; berry globular, many-celled, with numerous seeds in each. One species, viz. the marmelos, a tree with thorny branches; fruit delicious to the taste, and exquisitely fragrant: seeds imbedded in an extremely tenacious transparent gluten.

ÆGOPODIUM, in botany, a genus of the pentandria digynia class of plants. There is but one species, viz. the podagraria, *gout weed*, which is a perennial, creeping weed, with white flowers that appear in May or June. It grows in hedges, and in shady pla[illegible]

ÆNIGMA denotes any dark saying or question, wherein some well known thing is concealed under obscure language.

ÆOLIC *dialect*, among grammarians, one of the five dialects of the Greek tongue, agreeing in most things with the Doric dialect.

Æolic *verse*, in prosody, a kind of verse, consisting of an iambus or spondee, then of two anapests, separated by a long syllable.

ÆOLIPILE, an instrument, mentioned in several philosophical works, as being of great antiquity, although the original use of it seems to be totally unknown. It consists of a hollow metal ball, in which is inserted a slender neck or pipe; whence, after the vessel has been partly filled with water, and heated, issues a blast of vapour, with great vehemence. It has been used by lecturers in natural philosophy to demonstrate the possibility of converting water into an elastic vapour. When used, it is placed on a small carriage, to which it gives motion in a direction contrary to that in which the stream of vapour issues.

ÆOLUS'S *harp*, or ÆOLIAN *harp*, a musical instrument so named from its producing an agreeable harmony merely by the action of the wind.

ÆRA, a fixed point of time, from which any number of years is begun to be reckoned. See CHRONOLOGY.

AEROSTATION, is a term commonly applied to the art of raising heavy bodies into the atmosphere, by the buoyancy of rarefied air, or by gases of small specific gravity enclosed in an envelope, which, from being usually in a spherical form, is called a balloon. Various shapes have been tried; but it has been ascertained that the globular admits the greatest capacity under the least surface, and is, therefore, best fitted for the purpose of aerostation. Balloons are generally made of lutestring, and covered with an elastic varnish, to render the substance impervious by the gas. The weight which they are capable of raising will be in proportion to the diameter of the sphere. From the latest and most accurate calculations, it appears that a cubic foot of hydrogen gas has, by itself, a buoyancy of about one ounce avoirdupois. Hence a balloon of ten feet diameter will have an ascensional force of full 524 oz. or about 33 lbs. *minus* the weight of the material of which it is made; and one of thirty feet diameter, will have a buoyancy of nearly 890 lbs. *minus* the weight of the stuff of which it is made.

In all scientific pursuits, utility ought certainly to be the point of aim. We do not affirm that aerostation never can be rendered essentially subservient to the interests of society; yet it must be confessed that, after numerous attempts, during the lapse of nearly a century and a half, nothing has been effected beyond a few meteorological observations, and the reconnoitering of an enemy's camp from a great altitude in the air, perhaps too great to admit of sufficiently minute observation. The very latest attempts that have been made by aeronauts to ascend into the higher regions seem to have been made chiefly with the view of affording amusement to the public; and, indeed, in its present state, aerostation seems incapable of producing any thing beyond that. Viewing it, therefore, in this light, but, at the same time, as a *scientific amusement*, which, it is hoped, may terminate in some useful discovery, we shall here subjoin a very simple method of constructing an air balloon.

Suppose it be required to construct a balloon of 10 feet in diameter, find by the common rule, the circumference, which will be 31.428, or about 31 feet 5 inches. Divide this by 12, and the quotient will give the width of one of the gores of which the envelope is to be made. To form this gore, draw the line AB, fig. 1, plate 1, of any convenient length; and, about the middle of this line, draw, at right angles with it, the line CD. Then measure off on the line EB from the point E, the distance E f, which must be exactly half the width of the gore; repeat the same on EA, which will give the distance E g, and the points g f will then be asunder the width of the gore. From g, on the line g B, set off towards B 10 times the space g f, and the point B will then be the centre of the segment C g D: with the same radius from the point A describe the segment C f D then C g D f will be the required gore, from which the others may be readily formed. In cutting the gores, about a quarter of an inch more than the breath of the pattern should be allowed all round for the joinings. When the gores are prepared, if it is intended to inflate the balloon with gas, they should be carefully varnished with a solution of caoutchouc in rectified oil of turpentine, in the proportion of one part of the former to thirty-two of the latter; but for rarefied air balloons this is not necessary. In large balloons, the joinings should be sewed, and a warm iron should be passed over the seams to cause the gum varnish to fill up every little imperfection, and render th[illegible]hole air-tight. There must also be a v[illegible] opening inwards fixed in the top of the balloon, pressed close by a spring, for the purpose of letting off the gas when it is required to descend, from which a string must descend into the car where the aeronaut is seated.

With regard to the inflation of the machine, it may be accomplished with very great ease in any town where there is a gas establishment, by inserting into the opening at the bottom a flexible pipe, connected with the nearest convenient part of the main pipe from the gasometer.

When this advantage cannot be commanded, the balloon may be filled with gas produced in the following manner. Into any number of casks, as in fig. 2. plate 1, put a quanti[illegible]f iron chippings, or turnings, the coarser the better; over which pour vitriolic acid, diluted with about seven times its weight of water hydrogen gas will be immediately disengaged in great abundance. The gas may be conveyed by tin or copper tubes from these casks into another of larger dimensions, as B, in which another cask A is to be placed. The vessel B being nearly filled with water, and the tubes from the surrounding casks reaching to the bottom of it, and terminating within the open end of the cask A, the gas will rise through the water, and be collected in A, from whence, by a flexible pipe, it is conveyed directly into the balloon, which, during this process, is suspended by a rope between two upright poles, and the lower part held down by means of heavy weights attached to cords, as seen in the figure. When the inflation is complete, the balloon must be detached from the weights, the suspending cord being dexterously withdrawn, and it will then rise majestically into the air. The car in which the aerial navigators are seated should be made of wicker work, covered with canvass, or leather painted and varnished, and attached to a frame of net work, which must reach about half way down the body of the balloon.

Balloons made of varnished post paper are

sometimes used by philosophical lecturers of a size sufficiently small to be let out, when filled, by the window or door of the lecture-room. These may be filled with gas generated from granulated zinc, and diluted vitriolic acid, in the simple apparatus described by Mr. Cavallo, and represented fig. 3. plate 1, where A is a bottle with the ingredients; BCD a tube fastened in the neck at B, and passing through C, the cork of the other bottle, in which there is a hole made to receive the tube, and to this the balloon is to be tied. Thus the gas, coming out of the tube D, will pass first, through the water in the bottle E, and from thence into the balloon.

It must not be here omitted to notice, that the trouble of preparing small balloons for this purpose is now entirely superseded by an article sold by all mathematical and philosophical instrument makers, prepared from the stomach of the turkey. It may be filled in one minute, and will roll about against the ceiling of the lecture room for a considerable time.

Many of the accounts which are recorded of aerial voyages carry with them a good deal of interest, but in this respect they are all surpassed by that of the French aeronaut M. Garnerin. This gentleman, in September, 1802, ascended alone in his balloon from St. George's Parade, North Audley Street, [illegible] descended soon after into a field near the Small Pox Hospital, St. Pancras.

To the balloon was suspended a parachute, in the manner of a large umbrella when shut, at the extremity of which was a circular basket, wherein M. Garnerin sat. When the balloon was filled, the aeronaut placed himself in the basket, and ascended amidst the applause of innumerable spectators. In about eight minutes, the balloon being at an immense height, M. Garnerin cut the rope, and instantly was disengaged from the balloon in his parachute, which fell rapidly, and, on its expansion, began to vibrate like the pendulum of a clock. Every beholder was alarmed for the safety of M. Garnerin, who, however, landed safely, though he sustained some severe shocks in his descent. Mr. Blanchard appears to have been the first who constructed the parachute, the design of which was to facilitate his descent in case of accident. Fig. 4. plate 1, represents this instrument in its collapsed state, having a small car suspended from the lower part; and fig. 5. shews the same when spread fully out, during the descent.

ÆRVA, in botany, a genus of the monadelphia decandria class and order: the flowers are polygamous, calyx five-leaved, and patent; the stamina are five. There is but one species, which is a native of Arabia.

ÆSCHYNOMENE, or **Bastard Sensitive Plant**, in botany, a genus of the diadelphia decandria class and order, and of the natural order papilionaceæ, of which there are twelve species found native in the East Indies. One of the species is treated as hemp, and used for the same purpose.

This shrub takes its name from a Greek word which signifies *to be ashamed*, because it retreats from the touch.

ÆSCULUS. **The Horse Chesnut**, in botany, a genus of the heptandria monogynia class and order, of the natural order trihilatæ; there are three species, viz. the common horse chesnut, brought originally from Asia into Europe; the yellow flowered horse chesnut, a native of North Carolina; and the scarlet horse chesnut. The wood of the common horse chesnut is chiefly used for water pipes, turner's ware and fuel; it should be felled in November.

The nut has been employed in France and Switzerland for the purpose of bleaching yarn, and is recommended in the Memoir of the Society of Berne, vol. ii. part 2, as capable of extensive use in whitening not only flax and hemp, but silk and wool.

ÆSHUSA, in botany, a genus of the pentandria digynia class and order, and belonging to the natural order of umbellatæ, or umbelliferæ. It is commonly called fool's parsley, or lesser hemlock, which is known to be poisonous; it may be distinguished from common parsley when in flower, but the most effectual method of preventing the bad consequences of mistake, is, to cultivate the curled parsley only.

ÆTNA, a famous volcanic or burning mountain in Sicily, situated on the eastern coast, not far from Catania. The height of this mountain is above 10,000 feet above the surface of the sea, and its circumference at the base is 180 miles. Over its sides are seventy-seven cities, towns, and villages, the number of the inhabitants of which is about 115,000 From Catania to the summit is the distance of thirty miles, and the traveller must pass through three distinct climates, which may be denominated the torrid, the temperate, and the frigid.

AFFIDAVIT is an oath in writing, taken before some person who is legally authorized to take the same.

In an affidavit, the time, place of habitation, and addition, of the person who makes it, are to be inserted.

AFFINITY, among civilians, denotes the relation of each of the parties married to the kindred of the other. Affinity is of three kinds: 1. Direct affinity, or that subsisting between the husband and his wife's relations, by blood; or between the wife and her husband's relations. 2. Secondary affinity, or that which subsists between the above mentioned parties by marriage. 3. Collateral affinity, or that which subsists between the husband and the relations of his wife's relations. The degrees of affinity are always the same with those of consanguinity. In chemistry, affinity signifies that attractive power manifest between the different parts of bodies, whereby they combine with each other.

AFFIRMATION is used for the ratifying or confirming the sentence or degree of some inferior court: thus we say, the House of Lords affirmed the decree of the Lord Chancellor, or the decree of the Lords of Session.

Affirmation also signifies an indulgence granted to the people called Quakers, who, in cases where an oath is required from others, may make a solemn affirmation that what they say is true.

AFFRAY, or **Affrayment**, in law, formerly signified the crime of affrighting other persons, by appearing in unusual armour, brandishing a weapon, &c. But it now denotes a skirmish or fighting between two or more; and there must be a stroke given, otherwise it is no affray.

AFFRONTEE, in heraldry, an appellation given to animals, facing each other on an escutcheon.

AFT, in the sea language, the same with **Abaft**, which see.

AFZELIA, in botany, a genus of the didynamia angiospermia class and order; there is but one species, found in Africa near the equator.

AGAPANTHUS, a genus of the hexandria monogynia class and order, of the natural order of the liliacæ. There is but one species, viz. A. umbellatus or African blue lily. It is a native of the Cape of Good Hope, from whence it was brought to Holland, and in 1692 it was cultivated at Hampton Court.

AGARICUS, in botany, a genus of the order of fungi, and class of cryptogamia; the pillus or cap has gills underneath, and the gills differ in substance from the rest of the plant, being composed of two lamina, and the seeds are in the gills.

There are nearly four hundred species, but of all these one only has been selected for cultivation in our gardens, viz. the campestris. This species is the best and most savoury of the genus; it is eaten fresh either stewed or boiled, and preserved either as a pickle or in powder: and furnishes the sauce called catchup.

The wild mushrooms are found in parks, and other pastures, where the turf has remained long unploughed.

AGATE, a mineral whose basis is calcedony, blended with variable proportions of jasper, amethest, quartz, opal, heliotrope, and carnelian Some species of the agate when cut across and polished, present a beautiful appearance, exhibiting various figures. They were formerly supposed to be produced by deposits of iron or manganese, but it is now thought they arise from mineralized plants of the cryptogamia class.

AGATHOPHYLLUM, a genus of the dodecandria monogynia class and order; calyx very minute, truncate: petals six, inserted into the calyx. There is but one species, viz. the aromaticum, a tree in Madagascar.

AGAVE, in botany, a genus of the hexandria monogynia class and order, of the natural order of coronariæ.

There are seven species, the principal of which is the A. Americana, or great American aloe, whose stems when vigorous, rise upwards of seventy feet high, and branch out on every side, so as to form a kind of pyramid, composed of greenish yellow flowers, which stand erect, and come out at every joint.

The leaves, when pressed, yield a thick juice, which, with lye-ashes, is made up into balls and used instead of soap.

AGE, denotes certain periods of the duration of the world. Thus among Christian chronologers, we meet with the age of the law of nature, which comprehends the time between Adam and Moses; the age of the Jewish Law, which takes in all the time from Moses to Christ; and lastly, the age of grace, or the number of years that have elapsed since the birth of Christ.

AGEMOGLANS, **Agiamoglans**, or **Azamoglans**, in the Turkish customs, Christian children raised every third year, by way of tribute, from the Christians tolerated in the Turkish empire. The collectors of this odious tax used to take one child out of three, selecting always the handsomest.

AGENT, in law, a person appointed to transact the business of another. It is a principle of law, that whenever a man has a power, as owner, to do a thing, he may, as consistent with his right, do it by deputy, either as agent, factor, or servant.

AGERATUM, *maudlin*, in botany, a genus of the syngenesia polygamia æqualis class of plants, with a monopetalous personated flower; and an oblong membranaceous fruit, divided into two cells, which contain a number of minute seeds, affixed to a placenta. There are two species.

AGGREGATE, in botany, is a term used to express those flowers which are composed of parts or florets, so united or incorporated by means either of the receptacle or calyx, that no one of them can be taken away without destroying the form of the whole.

Aggregate, in the Linnæan system of botany, is one of the natural methods of classing plants, and comprehending those which have aggregate flowers.

AGGREGATION, in chemistry, denotes the adhesion of parts of the same kind. Thus, pieces of sulphur united by fusion form an aggregate.

AGIO, in commerce, a term chiefly used in Holland and at Venice, where it denotes the difference between the value of bank stock and the current coin. Money in bank is commonly worth more than specie: thus, at Amsterdam, they give 103 or 104 florins for every 100 florins in bank. At Venice, the agio is fixed at 20 per cent.

AGRICULTURE, is the science which explains the means of making the earth produce, in plenty and perfection, those vegetables which are necessary to the subsistence or convenience of man, and of the animals reared by him for food or labour. Its practice demands an extensive knowledge of the relations subsisting between the most important objects of nature Hence every improvement made in this science must be considered as of high utility. Within the last twenty years, the progress of improvement, in every department of husbandry, has been rapid and extensive beyond all former experience. This has, no doubt, arisen from the laudable zeal with which the arts and sciences have, during that period, been cultivated; for, as it respects the bearing of agricultural pursuits on the interests of society, the motives for improvement must have been always nearly the same.

The limits of this work will not admit of an enlarged view of this subject, important and interesting as it is; nor indeed, is it at all here necessary, since the agriculturist will find the most ample details on every point of real importance in the works of several eminent writers, whose scientific researches, joined to extensive experience, entitle them to a high degree of respect and attention. We shall, therefore, confine this article to such a view of the subject as may prove of general utility.

On Inclosing and Draining. Inclosing of lands may be considered as the grand foundation of all improvements, both as it regards the prevention of litigations between proprietors, and the safety, and even the quality of the produce.

In connexion with inclosures, we may consider the practice of draining lands, as the

next step towards rendering them productive. A superabundance of water [illegible] no less injurious to the land, than the want of it; hence it becomes an object of great importance to the farmer to prevent its pernicious consequences. The formation of the drain must be regulated according to the nature of the soil. Where the open drain is used, care should be taken that it be about three times the width at top that it is at the bottom, otherwise the sides are apt to fall in. Open drains should be cleared once every year.

Where the soil admits the passage of water freely through it the hollow drain may be introduced with success. The usual depth of this drain, is from two feet to two feet and a half, and sometimes three feet. The stones must lean towards each other, so as to form a triangle, the bottom being the base. Stones, however, cannot always be procured; in which case, hollow drains should be filled up with any light open substances that will at once bear up the covering, and permit the water to flow with ease through them. Various substances are recommended for this purpose, such as thick ropes of twisted straw, faggot wood, horn, bones, turf, &c. but, perhaps, the white thorn may be pronounced superior to any thing hitherto used.

FENCES. The principal things to be attended to in the making of fences are, the size of the farm, the degree of exposure, the form of the fields, and the equability of the soil. As to the materials of which fences should be composed, it must be obvious that stone is superior to any thing else. Unless, however, in raising stone fences lime mortar be used, which in many situations is attended with too great an expense to be adopted, there is the unavoidable disadvantage of their going to decay, and in some cases, requiring to be entirely rebuilt once in twenty years.

Next to stone walls, the *white thorn* hedge may be recommended as being extremely durable, and kept up at a very moderate expence when it has been brought to perfection.

The planting of trees in fences, gives a very rich appearance to the landscape; but it is now generally allowed that they are in many respects hurtful to the hedge itself, and also to the crops to a considerable distance on each side; and it is well known how much the highways suffer from their shade.

IRRIGATION. The judicious management of the process of irrigation is of vast importance to the farmer. No one method of improving land brings a more speedy remuneration; the advantage resulting from it, is reckoned to amount to about a guinea per acre.

It is necessary to attend particularly to the facility with which the water can be drawn off the land, since the quicker this can be effected the better.

If the water is allowed to stand on the land too long, a white scum will be observed rising on those parts where it has stagnated, and the warmer the season, the sooner will this occur.

It is the opinion of some, that the clearer the water is that is used in irrigation, the more beneficial are its effects; but experience is directly opposed to this opinion: for every meadow is found productive in proportion to the quantity of mud collected from the water: and so well is this fact now established, that many persons employ labourers, for several days together, to disturb the mud at the bottom of the rivers, that are to supply the meadows with water.

The spring feeding should always be done by sheep, or calves, as the heavier cattle are apt to injure the ground with their feet, while it is soft from the effects of watering.

MANURES. The application of various substances to land, for the purpose of enriching it, has deservedly occupied the attention of some of the most eminent men of science, of which the present age can boast. To enumerate the various species of manure that may be successfully used, would far exceed our limits; we shall therefore only mention the principle, which are these, chalk, lime, shells, bones, gypsum, marl, clay, sand, pond-mud, pond-weeds, ashes, soot, sea-weeds, salt, rape dust, malt dust, yarn, dung, pigeon's dung, rabbit's dung, night soil.

To apply these substances with advantage evidently requires some knowledge of their chemical properties, and also of those of the soil they are intended to benefit. The following remarks of Dr. Ure, are so strictly appropriate to this subject, that we shall give them at length. "When we consider that every change in the arrangements of matter connected with the growth and nourishment of plants; the comparative values of their produce as food; the composition and constitution of soils; and the manner in which lands are enriched by manure, or rendered fertile by the different processes of cultivation, we shall not hesitate to assign to chemical agriculture a high place among the studies of man. If land be unproductive, and a system of ameliorating it is to be attempted, the sure method of attaining this object is by determining the causes of its sterility, which must necessarily depend upon some defect in the constitution of the soil, which may be easily discovered by chemical analysis. Some lands of good apparent texture are yet eminently barren; and common observation and common practice afford no means of ascertaining the cause, or of removing the effect. The application of chemical tests in such cases is obvious; for the soil must contain some noxious principle which may be easily discovered, and probably easily destroyed. Are any of the salts of iron present? They may be decomposed by lime. Is there an excess of siliceous sand? The system of improvement must depend on the application of clay and calcareous matter. Is there a defect of calcareous matter? The remedy is obvious. Is an excess of vegetable matter indicated? It may be removed by liming, paring, and burning. Is there a deficiency of vegetable matter? It is to be supplied by manure. Peat earth is a manure; but there are some varieties of peats which contain so large a quantity of ferruginous matter as to be absolutely poisonous to plants. There has been no question on which more difference of opinion has existed, than that of the state in which manure ought to be ploughed into land; whether recent, or when it has gone through the process of fermentation. But whoever will refer to the simplest principles of chemistry, cannot entertain a doubt on the subject. As soon as dung begins to decompose, it throws off its volatile parts, which are the most valuable and most efficient. Dung which has fermented so as to become a mere soft cohesive mass, has generally lost from

one-third to one-half of its most useful constituent elements."

THE CULTURE OF GRASSES. The purposes for which grass lands are required are two; *first*, for affording hay, and when laid out for this purpose they are called meadows; *secondly*, for the growing of herbage for the support of cattle, they are then termed *pastures*. When ploughed lands are to be laid down for meadow or pasture, the soil should be thoroughly pulverized by ploughing and harrowing; the seeds should be sown after some hoeing crop, as turnips, or cabbages; damp weather is the most suitable for the purpose; and the seed can hardly be sown in too great abundance. To form a good turf, requires much labour and attention; and when once produced, it ought never to be broken up without the certain prospect of advantage by the change.

An agriculturist of great eminence has given the following arrangement of grasses adapted to the different soils.

Clay.	*Loam.*	*Sand.*
Cow grass,	White clover,	White clover,
Cock's-foot,	Rye,	Rye,
Dog's-tail,	York white,	York white,
Fescue,	Fescue,	Yarrow,
Fox-tail,	Fox-tail,	Burnet,
Oat grass,	Dog's-tail,	Trefoil,
Trefoil,	Poa,	Rib.
York white,	Timothy,	
Timothy	Yarrow,	
	Lucerne.	

Chalk.	*Peat.*
Yarrow,	White clover,
Burnet,	Dog's-tail,
Trefoil,	Cock's-foot,
White clover,	Rib,
Sainfoin.	York white,
	Rye,
	Fox-tail,
	Fescue,
	Timothy.

In our meadow and pasture lands we find a great variety of grasses, of which some are far more valuable than others; to know the good from those which are indifferent becomes the interest of the farmer; we therefore give him the characters of the most valuable.

1. Great smooth stalked meadow grass—Poa pratensis.
2. Hard fescue grass—Festuca duriusculo.
3. Meadow fescue grass—Festuca pratensio
4. Ray grass—Lolium perenne.
5. Meadow fox-tail grass—Alopecurus pratensis.
6. Sheep's fescue grass—Festuca ovina.
7. Rough stalked meadow grass—Poa trivialis.
8. Marsh meadow grass—Poa palustris.
9. Com[illegible] meadow grass—Poa compressa.
10. Crested dogs' tail grass—Cynosurus cristatus.
11. Knotty cats' tail grass—Phleum nodosum.
12. Sweet scented spring grass—Anthoxanthum odoratum.

Great or smooth-stalked meadow grass. This grass is considered as the best of all we have; it is early in its foliage, makes the best hay, affords the richest pasture, all sorts of cattle are fond of it. it is in all our meadows, and will continue in the same land much longer than any other grass.

Hard fescue. This is an early and productive grass, wi[illegible]e foliage, which grows well on downs and rich meadows. It is well adapted for being combined with other grasses in forming sheep pastures, and stands high in esteem as a very good hay grass.

Meadow fescue grass. This is a grass that comes near in its appearance to rye grass, but to which it seems greatly superior, as being larger, and more productive of foliage. It is strictly perennial and hardy, thriving well in most soils, growing in all situations; and it abounds in the best meadows, in the best hay districts; is sweet, luxuriant, and quick of growth, affording rich pasture, and making good hay.

Ray or rye grass. This is a sort of grass that has been much in cultivation, but is deficient in some of the properties necessary for meadow or pasture lands. In rich moist meadows its foliage is abundant; and it seems probable that it is highly acceptable and nutritious in feeding cattle; its foliage is of rapid growth, and flowering stems continually shooting forth. It is best adapted to the loamy and sandy descriptions of soils; but it will succeed on any except stiff clay, and even on that it may be grown.

Meadow fox-tail grass. It is in some measure distinguished by the largeness of its foliage, which is rather coarse, and by its producing a soft spike on a long stalk, early in May. If it be mown early, just as it comes into bloom, the hay will not be coarse. It shoots very rapidly after mowing, and produces a plentiful aftermath.

Sheep's fescue. This grass is praise-worthy both for the purposes of pasture and hay; sheep and other sorts of stock are fond of it, and are soon rendered fat in pastures where it prevails, giving to mutton a sweet delicious flavour.

Rough-stalked meadow grass. It delights in moisture, and situations that are sheltered; on which account, though there are few more productive, or better adapted for the purpose of hay or pasturage, it is tender, and liable to be injured by severe cold or drought; and in moist rich ground it has been observed to grow tall, while in poor land it has been found equally diminutive. It is well adapted to sound, moist loams; and the produce is excellent for all sorts of cattle.

Marsh meadow grass. This is a fine exuberant grass, and one of the best dairy grasses we have. It grows in all our rich marshes, which are subject to be flooded in winter; and rises in general, to the height of four feet.

Compressed meadow grass. This is an excellent grass for parks and sheep walks, deer and sheep being remarkably fond of it; it makes a fine turf, and renders the flesh of the animals short, and well flavoured.

Crested dogs' tail grass. This grass grows best in dry pasture land, and will not thrive in meadows that are very moist. Its thick tufts afford much food for sheep in the time of snow, and severe weather in the winter season. Its growth being rapid, it should be cut down quickly.

Knotty cats' tail grass, is a fine exuberant grass, very fit for dairy pastures, and for cow-hay. It produces abundance of milk; and cattle are very fond of it.

Sweet scented vernal grass. This grass comes early into blossom; it may be raised on almost any soil, but in point of crop it is not quite so productive as some other grasses. It is the only grass of this climate which is odoriferous; the agreeable scent of new made hay being produced almost entirely by it.

INSTRUMENTS AND OPERATIONS OF HUSBANDRY.—The instruments used in husbandry are so numerous, and, under the same denomination, often so differently constructed, with a view to varieties of the same operation, that it would be impossible in a sketch like the present to detail their structure and application. In the process for which they are respectively intended, every agriculturist will of course avail himself of those, the utility of which is best decided by experience.

PLOUGHING.—In almost all lands there is a fixed depth for the plough to go to, which is the stratum between the fertile and unfertile moulds. No soil should be ploughed beyond this bottom, or sole, which is the preservative on which the top layer should rest, and by which the manure laid upon the ground is prevented from losing its effect. In fallowing land, therefore, the plough may go as deep as the fertile soil will allow, as also in breaking up land without paring and burning. When land is pared and burnt, it ought to be ploughed in small furrows, and not so deep, as this depth of furrow would hazard the loss of the ashes for the immediate, and indeed for the subsequent crops.

Stubble ought never to be ploughed into the land; it is much better to mow it, and even to harrow the land before it is fallowed.

It is necessary to observe a due proportion between the depth of the ploughing, and the quantity of manure usually spread; ploughing before harrowing will always be found of great consequence in fallow grounds.

Fallows ought always to be kept very clean; indeed this must be attended to at all events, whatever other business may demand the attention of the husbandman.

Harrowing is necessary both for covering the seed, and for preparing the land for its reception. In the construction of the harrow, great care should be taken that the teeth be placed so as that no one tooth shall follow the tract of another. Harrowing is best performed by going over a square piece at a time, so that the harrow may be lifted at the corner, and the refuse stuff left there.

Till of late years the practice of rolling was but little used, or even known, and it is in many places exercised so slightly, as to be of little service. Its utility, when it is exercised as it ought to be, consists in rendering a loose soil more compact and solid, which, by making the earth adhere to the roots of plants, cherishes their growth. No roller that can be drawn by two, or even by four horses, will carry this effect too far. By rolling, moreover, the moisture of the earth is kept more in, and, in a dry season, this circumstance may reasonably be presumed sometimes to constitute the difference between a good and a bad crop. The common practice of breaking clods by means of mallets may judiciously be superseded by the roller, preceded for a day or two by harrowing.

For grass lands it is obvious that the mowing for hay is [illegible]ly facilitated by rolling.

What is termed scarifying of grass lands is used by a variety of persons, and is directly opposite, in its principle, to that of rolling them.

For this purpose, a plough, consisting only of coulters, or narrow teeth, is employed; and it is asserted, that the crops of hay are considerably increased by the loosening of the earth occasioned by this process, the roots acquiring the power of fresh vegetation. The operation may undoubtedly be beneficial in various instances and soils. The use of the roller, however, upon grass lands of a certain description will be admitted to be preferable.

BROADCAST AND DRILL HUSBANDRY.—There are three methods of sowing seeds in use. The *first,* which is the oldest method, is called the *broadcast system;* by this method the seeds are scattered by the hand, over the surface of the ground; *secondly,* the seeds may be dropped at equal distances and in straight rows; this is called the *drill system; thirdly,* small holes are made in the ground, and the seed dropped into them by the hand: this method is called dibbling.

The broadcast system, which is still much practised, is liable to many serious objections. It is impossible, even with the greatest care, and the most extensive experience, to scatter the seed so that an equal quantity shall fall on every part of the surface.

The grain must sometimes fall from the hand in heaps, and in this case part of it must perish; it will likewise be harrowed in at various depths; and with the greatest care, part of it will remain a prey to birds. The consequences of such irregularity must be too obvious to require remark, and yet the system is persevered in by many, from mere prejudice against modern improvements.

In the drill husbandry, no more seed is committed to the ground than what is likely to spring up, and the whole is almost certain to come to maturity. The advantages of the drill system are these: 1. The seed is disposed in equidistant rows. 2. It is deposited at a fixed depth. 3. In any given portion of each row, it is very nearly the same in quantity. By the first of these the method of horse hoeing is obtained· the second secures the uniform growth of the crop; and by the third, the seeds are prevented from injuring each other by their proximity, while there is no loss of ground by the want of a greater quantity of seed.

Dibbling is performed thus. After the land has been prepared by ploughing, harrowing, and rolling, a man having in each hand a staff, about three feet long, pointed with iron, makes two holes at once, as he moves backwards, taking care to keep the successive holes as nearly as possible in a straight line, and at regular distances. Two or more children attend him, and drop two, three, or four seeds into each hole.

These are afterwards covered in by passing a light harrow over the land. This system may be practised with advantage, where the state of the land is too rugged to admit of the drill. The expenditure of seed by this method is so small, that three pecks of wheat will serve for an acre.

ROTATION OF CROPS.—Various causes operate to render the alternation of crops an indispensable part of successful husbandry. As soils are exhausted of those principles which are neces-

sary to the growth of any particular crop, by the unintermitted succession of it; the most effectual means of relieving the soil, and of obtaining from it the maximum of produce, is found to consist in such a rotation of crops as will draw from it different principles, or different quantities of the same principles.

Thus white crops, such as wheat, oats, &c., are extremely exhausting, but afterwards the soil will bear a good crop of beans, turnips, or tares.

The following rotation of crops has been recommended by an eminent and experienced agriculturist, where the turnips, peas, and beans, are put in double rows on three-feet ridges: the cabbages, in single rows of three-feet ridges; and the whole hoed and cleaned with the utmost care.

Clay.	*Clayey loams.*
Turnips or cabbages,	Turnips or cabbages,
Oats,	Oats,
Beans and clover,	Clover,
Wheat,	Wheat,
Turnips or cabbages,	Turnips or cabbages,
Oats,	Barley,
Beans and vetches,	Beans,
Wheat.	Wheat.

Rich loams and sandy loams.			*Peat earth.*
Turnips and potatoes,	Beans,	Turnips,	Turnips,
	Barley,	Barley,	Barley,
Barley,	Peas,	Clover,	Clover,
Clover,	Wheat,	Wheat,	Wheat,
Wheat,	*Ad infin.*	Potatoes,	Potatoes,
Beans,		Barley,	Barley,
Barley,		Peas,	Peas,
Peas,		Wheat.	Wheat.
Wheat.			

Chalky substratum.	*Gravels.*	*Light lands.*
Turnips,	Turnips,	Turnips,
Barley,	Barley,	Barley,
Clover,	Clover,	Clover and rye-grass,
Wheat,	Wheat,	Clover and rye-grass,
Potatoes,	Potatoes,	Clover and rye-grass,
Barley,	Barley,	Peas,
Peas,	Peas,	Wheat or rye.
Wheat.	Wheat.	

REAPING AND STORING.—When artificial grasses are to be turned into hay, they should be treated in a manner different from that adopted with regard to natural ones. They ought to be allowed to lie in swarth for a day or two; after which, being turned with care, they should lie a day or two longer; by this simple process the hay is, in good weather, sufficiently made. After remaining two days in cocks, these should be carried to the stacks.

The mowers should cut the grass as low as possible, and five makers are not too many for every mower. The grass should be shaken out immediately after the scythe. By the evening it should be raked into rows. The next morning it should be again shaken and spread, and in the evening it should be put up into cocks. These being opened on the following morning, after a similar process, may, in fine weather, be safely collected into the great hay-cock at night. If successive rains come on to damage it, as it is stacked, a peck of salt should be strewed in layers on every load. The stack should be covered within a week after it is finished. To preserve as much of the sap of grass as possible, without incurring the danger of firing, is the grand practical problem of hay-making.

When the stems of culmiferous plants are totally divested of green, they are perfectly ripe. Wheat has been immemorially reaped; but barley, when the ground has been smoothed by rolling, may be cut down with the scythe. Cutting of corn in wet weather, ought ever to be avoided if possible. Barley is particularly subject to injury by wet. Peas grow so irregularly as to make the sickle necessary. Instead of housing corn, stacking is a far superior practice, as it not only, by the consequent exposure to the air, carries what is called a finer countenance, but as it is more completely preserved from vermin. Every sheaf should be made to incline downward, from its top to its bottom. The best form for a stack is that of a cone, placed upon a cylinder. The moment a stack is finished, the covering of it should commence.

THRESHING.—The usual mode of threshing, is attended with the inconvenience of the straw being very often not thoroughly cleared, by which, much grain is lost; and with that of affording the workmen great and perpetual incentives to depredation, which, perhaps, are rarely resisted, or, at least, are certainly often yielded to. A fixed threshing mill will give comparative security against these evils; and one worked by two or three horses may be purchased for from sixty to a hundred guineas, and which, in eight hours, will thresh fifteen quarters of wheat. The granary should be over this mill, and the corn may then, immediately after threshing, be drawn up into it, and deposited safe under the key of the farmer. Fresh threshed straw is better than old for feeding cattle, and is best managed for them by being cut into chaff.

FRUIT TREES.—The cultivation of fruit trees for the purpose of deriving from their juice a fermented liquor, employs a great proportion of the land of this as of other countries, and is, on that account, an important branch of agricultural attention.

The varieties of apples are entirely artificial, nature having only provided one species which is the crab. Apple trees should be cleared of redundance of wood, as it very much intercepts the free circulation of the air. They should be kept clear also of the misletoe, which often proves highly injurious to them; neither should moss be permitted on any account to incumber them.

As general management, with respect to orchard grounds, it is a judicious rule to plant for such, a broken-up worn-out sward, keeping it under arable, until the trees have attained tolerable growth, when it may, with advantage, be laid down to grass, and be permitted to remain in that state, till the trees are finally removed.

PLANTATIONS.—In planting timber trees it is of importance to suit the tree to the situation and soil, and at the same time to avoid making any uncertain sacrifice to obtain a thriving produce. The proper season for planting commences in October, and may be continued throughout the winter if the weather prove mild. In transplanting trees, the north side should be marked, and every tree should have the same aspect in its new situation as before, otherwise its growth will be checked. The

oest form for a plantation is that of a circle, as presenting the least surface of any figure for its area, and, consequently, this form will have the fewest outside trees, which are always stunted in their growth, at least more so than those which are more central.

The oak is generally found to thrive best in hilly situations, where there is a rich black soil. It is propagated by acorns, of which from four to six bushels are used on an acre; seeds of furze should be sown along with them to protect the young oaks from cold winds, and from rabbits.

The beech is also raised from seed; it delights in a calcareous or chalky soil. In exposed situations, Scotch firs are planted to shelter it, and afterwards cut down.

The elm is usually propagated from seed, or by suckers taken from the roots of old trees: it grows quickest on light soils, but produces the best wood on stiff soils.

The larch will grow on almost any soil, and in any situation; it will even flourish where other trees can hardly live, provided it has depth of root. It is of all resinous trees the most valuable on an estate, and makes a greater return than any other tree.

For Scotch firs a light sandy soil is the most suitable: it grows most rapidly, and attains the greatest height on the north and east sides of hills.

The birch and hazel may be raised in almost any situation; the ash requires a light, rich, calcareous soil: the poplar requires a moist soil, and thrives best by the banks of rivers: the willow is admirably suited for wet, marshy land; and in a few years its culture becomes exceedingly profitable.

Coppices are reckoned fit for cutting, in about fourteen years; and the proper season for felling, is from November till about the end of March, but not later, except for trees which are to be barked, for which May is the best month.

CATTLE.—Under this head the horse is the first subject of attention to the agriculturist. The following description of the horse best suited for agricultural purposes is truly excellent; it is from the treatise on *Live Stock*, by Culley.

"His head should be as small as the proportion of the animal will admit; his nostrils expanded, and muzzle fine; his eyes cheerful and prominent; his ears small, upright, and placed near together; his neck, rising out from between his shoulders, with an easy tapering curve, must join gracefully to the head; his shoulders, being well thrown back, must also go into his neck (at what is called the points) unperceived, which, perhaps, facilitates the going much more than the narrow shoulder; the arm, or fore thigh, should be muscular, and, tapering from the shoulder, meet with a fine, straight, sinewy, bony leg; the hoof circular, and wide at the heel; his chest deep, and full at the girth; his loin or fillets broad and straight, and body round; his hips or hooks by no means wide, but quarters long, and tail set on, so as to be nearly in the same right line as his back; his thighs strong and muscular; his legs clean, and fine-boned; his leg-bones not round, but what is called lathy or flat."

When corn is given to horses it should be previously bruised, as the grains which they swallow whole, lie undigested in the stomach, which will not act on the husk. The bruising is best done by the machine called the crushing machine, which bruises every grain that passes through it. Corn thus prepared will yield one fourth more nourishment than uncrushed grain.

The practice of soiling horses, instead of turning them to grass in summer, is allowed to be an excellent means of reducing the expense of keeping them, without either impairing their condition, or diminishing their capability of working. Turnips, carrots, and potatoes, afford an excellent winter food for horses, when green food cannot be obtained.

The horses best adapted to the general purposes of husbandry, are principally of three breeds: viz. the *Cleveland bays*, the *Suffolk Punches*, and the *Clydesdale horses*.

Black cattle, intended for feeding, should be chosen for their being short legged, which quality is almost uniformly connected with a general good make. Straightness of back another important recommendation, and the more perfectly straight they are, while at the same time, they are very broad and flat on the loins, the more readily experienced judges will decide on their worth. Smallness of dewlap, and the barrel form of carcase, both in the fore and hind quarters, are also justly insisted upon as points of excellence. A curled hide is indicative of a thriving beast, and worthy of observation in the choice of these animals. A still more favourable symptom is a softness or sleekness of skin. Indeed the nice touch of the hand is requisite in the judge of cattle, perhaps, nearly as much as the keen observation of the eye. Oxen that have been worked are more valuable to graziers than others, as not only fattening with greater rapidity, but furnishing more excellent beef. After working till the age of fourteen years, which is within two of the usual extent of their natural life, they have often supplied most tender and admirable meat.

When cattle become swelled by eating too much succulent food, they may be effectually relieved by being driven about for some time with great rapidity; but a still more successful method is to stab them with a knife, to the depth of four inches, between the ribs and the hip bone. A flexible tube also is sometimes passed through the mouth into the gullet, by which the air is discharged which causes the disease.

The value of a cow as a milker, should be determined not by the quantity of milk she affords, but by the quantity of cream which the milk yields.

SHEEP.—In the management of sheep, the different breeds must be adapted to the soil and situation where they are kept. The most common breeds are, the *new Leicester*, or *Dishley breed*, with long wool, having hairs, barrel shaped bodies, small heads, and an aptness to fatten early. The *Teeswater* breed of sheep; these are larger than any other; the ewes generally bring two or three lambs in a season, but this breed is only adapted to a soil that is warm, and highly fertile. The *black-faced*, or *Scotch sheep*, are best suited for bleak and mountainous tracts; they are small; their wool is very coarse, but their flesh is sweet, and the most scanty food will supply their necessities. The other breeds are, the Lincolnshire, the Romney-marsh, the Herefordshire, the South Down, and the Merino

or Spanish breed, &c. The lambing should be contrived to be in March, or early in April; The greatest difficulty attending this kind of stock is the supplying of suitable provision at this season, for if the growth of the lamb be checked, the evil is irremediable. The *rouen*, or after-grass, is the most valuable article in this case, as it is very wholesome, and much relished. Turnips also afford a good supply, and increase the quantity of the milk of the ewes; but a little hay should be given along with them.

Sheep that are kept in inclosures, and particularly in a woodland country, should be examined twice every day, to guard against injury to them from the fly, which in twenty-four hours after having struck, sometimes produces incurable disease. The most efficacious treatment on this subject is, after parting the wool wherever the maggots are found, and picking them out with a knife, to scrape a small quantity of white lead among the wool, so that it may be carried evenly down to the wound. Regular and minute inspection will prevent such a circumstance as a broken coat in any of these animals, from a cause so dangerous and fatal where they are neglected.

When ewes about to lamb, their keep should be of the most nourishing kind, consisting of plenty of turnips or cabbage. Till this period they may do without them. But all cattle that have young require as good keeping as those which are fatting. The turnips or cabbages should be drawn for them, and given them on dry gound. A standing rack of hay should be left for them on the field, which will be of great advantage to them.

Swine.—By proper management, swine may be rendered an important source of profit to the farmer; they are very prolific, and may be kept at little expense, since they consume immense quantities of food that would not be of any value to any other kind of live-stock. breeds are of different kinds, which vary much in size; the larger kinds should be kept only where provision of the best kind can be had in abundance. As the sow has two litters in the year, these ought to be so regulated as to have them both in mild weather; winter litters are not worth the trouble of rearing. Swine will fatten on almost any sort of food; and when corn is given them to prepare them for the market, it should be ground into meal, and mixed with water.

Soiling of swine is found to be highly advantageous, from the quantity of manure it produces; and although they are the filthiest of all animals, yet cleanliness is highly conducive to their health: warmth also is beneficial to them.

Poultry are more or less a part of the stock of almost every farm, and when they are reared with a view to profit, and on a large scale, they will be found to repay the great attention necessary to bring them to maturity.

A house should be erected for them, containing divisions appropriately for roosting, sitting, fatting, and food. The building should be constructed near the farm-yard, having clear water contiguous to it. Warmth and smoke are great cherishers of poultry. All, of every species, must have access to gravel and grass. Their cheapest food consists of boiled potatoes, on which it appears that they can be supported and fattened, without the aid of any corn. Where numbers of them are kept upon a farm, if permitted to go at large, they will often do considerable injury both in the fields and barn-yard, besides which they will be extremely exposed to the attacks of vermin, and will lose a considerable number of their eggs. A full-grown hen continues in her prime for three years, and may be supposed in that time to lay 200 eggs, which number, however, by warmth and nourishment, might be greatly exceeded.

The quality and size of the Norfolk turkeys are superior to those of any other part of the kingdom. They are fed almost entirely with buck-wheat, which, perhaps, may account for their excellence, and are bred by almost every little farmer in the county. When young, they demand perpetual attention, and must be fed with alum, curds, and chopped onions, and the expense attending their management and food can be compensated only where broods are tolerably successful, and the prices high.

The Dairy.—In selecting those cows which are most suited for the dairy, respect must be had, not so much to the quantity of milk which they give as to the quantity of cream which the milk affords.

The richest milk known is produced by cows of the Alderney breed. Much skill is required in managing a breed of milk cows; and none should be entrusted with the milking of them but those who can be fully depended on; an artful mildness of management, with a soft hand, and gentle touch, will render the operation of milking agreeable to the cow, the milk will flow freely to the last drop. This tender management will not only secure the continuance of the quantity of milk drawn at any particular time, but will even improve it; whereas if from want of skill a portion of the milk be left in the udder, the cow will eventually become dry. The usual practice is, to milk cows twice a day; but in the summer season when they have an abundance of succulent food, they may be milked three times.

The situation of a dairy is of importance. It ought to be well aired, yet as well shaded as possible; and its windows should never front the south, the south east, or south-west. Every utensil should be kept most scrupulously clean; hence a plentiful supply of water is indispensable.

The temperature of about fifty-five degrees is most favourable for the separation of the cream from the milk. The utensils of the dairy are best made of wood; lead and copper being soluble in acid, and highly pernicious; and though iron is not injurious, yet the taste of it renders the produce of the dairy unpalatable.

AGRIMONIA, *agrimony*, in botany, a genus of the dodecandria digynia class and order. Of this genus there are five species; the A. parviflora is found in the corn-fields and hedges in Britain, and in most parts of Europe it is perennial, and flowers in June and July. It is used in medicine as a cure for the jaundice: the Prussians use it for dressing leather.

AGROSTEMA, *the garland of the field*, in botany, a genus of the decandria pentagynia class and order. There are four species, viz. 1. A. githago, corns campion, or cockle. 2. A. coronaria, rose campion: 3 A flos Jovis; and 4. A. cœli rosa, smooth campion.

AGROSTIS, a genus of triandrious plants, called in English bent grass. It is of the class and order triandria digynia; the essential character is, calyx bivalve, one-flowered, a little less than the corolla; stigmas longitudinally shaped.

There are no less than thirty-five species of this grass; most of them are foreign, and some only annual. About eight species are enumerated as natives of Britain.

A-GROUND, expresses the situation of a ship, the bottom of which rests on the ground.

AGRYPNIA, denotes much the same with watchfulness, or an aptitude to sleep; which is a very troublesome symptom of feverish, and other disorders.

Agrypnia, in the Greek church, the vigil of any of the greater festivals.

AGUE, a general name for all intermittent fevers, which, according to the different times of the return of the feverish paroxysm, or fit, are denominated quotidian, tertian, or quartan agues.

AGYNEIA, in botany, a genus of the triandria monogynia class and order; there are but two species of this shrub, both natives of China.

A-HULL, denotes the situation of a ship when all her sails are furled, on account of the violence of a storm, and when having lashed her helm to the lee side, she lies nearly with her side to the wind and sea, her head being somewhat inclined to the direction of the wind.

AIGUISCE', Aiguisse', or Eguisce', in heraldry, denotes a cross with its four ends sharpened, but so as to terminate in obtuse angles. It differs from the cross fitchee, inasmuch as the latter goes tapering by degrees to a point, and the former only at the ends.

AILANTHUS, the tree of heaven, so called on account of its lofty growth; a genus of tree, the class and order of which are not ascertained: some accounting it polygamia monoecia, and some dioeccia decandria. It has male, female, and hermaphrodite flowers. It is a native of China, but grows very fast in our climate, and is recommended for ornamental plantations.

AIR, is a subtile, invisible, elastic fluid, surrounding the globe of the earth. It was formerly believed to be an elementary principle, but the researches of philosophy have long since exploded this theory, and it is now well known that this fluid is a compound of various ingredients, but consisting chiefly of two gases, viz. oxygen and azote.

For a more particular description of air, see the articles, Atmosphere, Gas, Chemistry, and Pneumatics.

Air-*Balloon.* See Aerostation.

Air-*Gun.* See Pneumatics.

Air-*Jacket*, a sort of jacket made of leather, in which are several bags, or bladders, of the same materials, and communicating with each other. These are all filled with air by means of a tube of leather, having a brass stopcock at the extremity. The use of the air-jacket is to support a person in water who is unable to swim.

Air-*Pipes*, an invention for drawing foul air out of the holds of ships, or any other place; the invention is ascribed to Mr. Sutton, a brewer in London, whence they are called Sutton's pipes. The principle on which their action depends is no other than that air is necessary for the support of fire; and if it has not access from the places most adjacent, will readily come from those that are more remote. Hence the fire kept up in a ship, for the necessary purposes, may be employed to consume all the foul air that may at any time be collected about the vessel.

Air *Pump.* See Pneumatics.

Air *Threads*, in natural history, a name given to the long filaments so frequently seen in Autumn, floating about in the air. These threads are the work of spiders, especially of the long legged field spider.

Air *Vessels*, are spiral ducts in the leaves of plants, &c. supposed to be analogous to the lungs of animals, in supplying the different parts of the plants with air.

AITONIA, in botany, so named from Mr. Aiton the late king's gardener at Kew, a genus of the monadelphia octandria class and order, and of the natural order of columniferae. There is but one species, a native of the Cape of Thunberg.

AJUGA, in botany, a genus of the didynamia gymnospermia class of plants: the flower is monopetalous and ringent, the upper lip being rather small and bifid; the lower one is large and trifid; no pericarpium; the seeds are contained in the cup of the flower: there are ten species.

AIZOON, in botany, a genus of the polyandria pentagynia class: there are ten species of this plant, all natives of hot countries, they may be raised in this country on hot beds, but they are not remarkable, either for beauty or any other property.

ALABASTER, a species of stone which has a greater or less degree of imperfect transparency, a granular texture; is softer and tal a dull polish than marble, and is usually of a white colour.

Alabaster is found in Germany, France, and Italy; it is used by sculptors for statues; and has sometimes been used in large thin slabs for windows, on account of its readily transmitting the rays of light. There is hurch at Florence illuminated in this way.

ALÆ, in anatomy, is sometimes used for the lobes of the liver, the nymphæ of the female pudendum, the two cartilages which form the nostril, the armpits, young stems or branches, &c.

ALATED, in botany, an epithet applied to the seed, stem, or leaf stalk: a seed is alated, when it has an ala or membrane affixed to it, which, by its flying, serves to disperse it.

ALAUDA, Lark, in ornithology, a genus of birds of the order of passeres; the characters of which are, that the beak is cylindrical, subulate, and straight, bending towards the point; the mandibles are of equal size, and opening downwards at their base; the tongue is bifid; and the hinder claw is straighter and longer than the toe.

Pennant observes that the nostrils are covered with feathers or bristles, and the toes divided to their origin. There are thirty three species; the principal are; -1. The A. arvensis, or sky-lark This bird and the wood-lark are the only birds which sing flying. The higher it flies, the more

it strains its voice, and, in descending, it lowers it until it quite dies away. 2. The A. pratensis or titlark. This bird has a remarkably fine voice, and frequents meadows. 3. A. arborea the woodlark, is distinguished by an annular belt of white encircling the head. It haunts uncultivated tracts near copses, but seldom penetrates the woods. 4. A. campestris, the meadow lark, it differs from the others by the blackness of its bill and feet; it inhabits heaths, and uncultivated tracts; and frequently oat-stubble, where birds of this species are often found to assemble in great numbers. 5. A. trivialis, the voice of this bird is weak, and resembles the cry of chickens: it builds its nest in solitary spots, concealed under turfs, hence its young frequently become a prey to adders. 6. A. cristata, or crested lark; this bird is found in most parts of Europe; it lives in the meadows and fields, on the sides of ditches, and on the backs of furrows. This is the only lark that may be instructed; in a month it learns many airs perfectly, which it repeats without confusion.

ALBINOS, the name by which the Portuguese call the white Moors, who are looked upon by the negroes as monsters. They, at a distance, might be taken for Europeans; but, upon a near inspection, their white colour appears like that of persons affected with a leprosy.

ALBUCA, a genus of the hexandria, monogynia class and order. The essential character is, corolla six petalled, inner ones difform, stamina three of the six castrated stigma, surrounded by six carps. There are eight species rather tender, but may be kept in winter in a garden frame.

ALBUMEN, in chemistry, a term to denote the white of egg, and all glary, tasteless substances, which, like it, have the property of coagulating into a white, opaque, tough, solid substance, when heated a little under the boiling point. This substance forms a constituent of many of the fluids of animal bodies, and when coagulated, it constitutes also an important part of their solids. Substances analogous to it have been noticed in the vegetable kingdom. The essential characters of albumen are the following: 1. In its natural state it is soluble in water, and forms a glary, limpid liquid, having very little taste: in this state it may be employed as a paste and a varnish. 2. The solution is coagulated by acids, in the same way as milk is acted upon; and also by heat of the temperature of 170°, and by alcohol. 3. Dissolved in water, it is precipitated by the infusion of tan; and also in the form of white powder by the salts of most of the white metals as silver, mercury, lead, and tin. 4. When burnt, it emits ammonia, and when treated with nitric acid, yields azotic gas.

ALCA, or Auk, in ornithology, a genus of the order of anseres. The beak of this genus is without teeth, short, convex, compressed, and frequently furrowed transversely: the inferior mandible is gibbous near the base; the feet have generally three toes. There are 12 species of the alca, of which the most remarkable are,

1. The impennis, northern penguin. 2. The alca, little auk. 3. The arctica, or puffin. 4. The torda, or razor bill. 5. The pica, or black-billed auk. 6. The cirrhasa, or tufted auk. 7. The psittacula, or parroquet auk.

ALCEA, The holly-hock, in botany, a genus of the monadelphia polyandria class of plants. It grows wild in the country of Nice: the colours of the holy-hock flowers are accidental; and the double flowers are varieties proceeding from culture. Gmelin enumerates five species of this plant: viz. the A. ficifolia, the rosea, the semensis, the acaulis, and the Coromandeliana.

ALCEDO, or Kingsfisher, in ornithology, a genus of the order of picæ. The alcedo has a long, straight, thick, triangular bill; with a fleshy, plain, short, flat tongue. Of this genus there are many species, with one or other of which almost every part of the world is furnished. Most of them frequent rivers, and live on fish, the singularity of catching which is admirable: sometimes hovering over the water, where a shoal of small fishes is seen playing near the surface; at other times waiting with attention, on some low branch hanging over the water, for the approach of a single fish which is so unlucky as to swim that way; in either case dropping like a stone, or rather darting with rapidity on its prey; when, seizing it cross-wise in its bill, it retires to a resting place to feast on it; which it does piecemeal, bones and all, without reserve, afterwards bringing up the indigestible parts in pellets, like birds of prey. The wings of most of the genus are very short; yet the birds fly rapidly and with great strength. It may be remarked, that throughout this genus, blue, in different shades, is the most predominant colour. There are above thirty species of this genus of birds according to some; others enumerate forty one.

ALCHEMILLA, or Ladies-mantle, a genus of the moongynia order, and terandria class of plants; and in the natural method ranking under the 35th order, senticosæ. The essential character is cal. 8 cleft, cor. none, seed one. There are 4 species; the principal are:

1. A. Alpina, or cinque-foil ladies-mantle. It is a native of the mountainous parts of Europe.

2. A. minor, or least ladies-mantle. It grows naturally in Sweden, Lapland, and other cold countries.

3. A. vulgaris, or common ladies-mantle, with leaves plaited like a fan, and yellowish green blossoms. It grows naturally in pasture lands in this as in most other other countries in Europe.

ALCHEMY, (from *al*, the, Arab, and χημια, chemistry,) that obsolete branch of chemistry which had for its principal objects the transmutation of metals into gold; the panacea or universal remedy; an alkahest, or universal menstruum; a universal ferment; and many other things equally ridiculous.

There is a remark by Mr. Gurney in his introductory Lecture, relating to this subject, which is worthy of notice, as being highly illustrative of the character of the clergy in every age.

"During the period at which the study of alchemy was most prevalent, it was professedly regarded as a high, and almost sacred art, fit only to be known and practised by the pure, the learned, and the wise. It was studied by the clergy more than by any other set of men

and such of the sacred edifices as now remain to us belonging to that period, exhibit numerous symbols and hieroglyphics of the art. In this country, in particular, many of the prelates of Westminster are known to have been adepts: and the abbey itself remains to this day not without allegorical symbols connected with this practice."

ALCHORNIA, a genus of the dioecia monodelphia class and order. The essential character is, male, calyx three, five-leaved; cor. none: female, calyx five-toothed, cor. none, styli two parted, caps. berried, decorous. There is one species, of which little seems to be known in this country.

ALCOHOL, commonly called *spirit of wine*, is obtained by distillation in a state more ardent and purified than that article. Spirit of wine is obtained by distilling farinaceous or sacharine roots, as well as the pulpy fruit of vegetables; it is purified by repeated rectification, and is called *alcohol* when digested of its aqueous particles. It is chiefly employed in preparing varnishes, in dissolving gum resins, and for various other purposes in medicine. The antiseptic power of alcohol renders it valuable in preserving anatomical preparations. It is also now much used for burning in lamps on account of the steady and uniform heat which it gives during combustion. Fourcroy reckons it to be rectified to the highest point when its specific gravity is 829, water being 1000.

It was long supposed that alcohol could not be solidified by congelation; but it appears from an account given by Dr. Hutton, in the Edinburgh Encyclopedia, that he succeeded in freezing it by a cold of 110°: the process, however, has not been made public.

ALCOR in astronomy, a small star adjoining the bright one in the middle of the tail of Ursa Major.

ALCORAN. See KORAN.

ALDEBARAN, in astronomy, a star of the first magnitude, called in English the Bull's-eye, being the eye of the constellation Taurus. Long. $6^{\circ}\ 32'\ 9''$ of Gemini. Lat. $5^{\circ}\ 29'\ 40''$ S.

ALDER, in botany. See Betula.

ALDERMAN, among our Saxon ancestors, was a degree of nobility answering to earl or count at present. It ranked inferior to atheling, but superior to thane. Alderman was also used in the time of king Edgar, for a justice or judge. In modern British policy, it implies a magistrate subordinate to the mayor of a city or town corporate. The number of these magistrates is not limited, but is greater or less according to the magnitude of the place. In London they are twenty-six; each having one of the wards of the city committed to his care. The office is for life.

ALDROVANDA, in botany a genus of the pentandria pentagynia class and order, of which there is only one species, viz. the A. vesiculosa, found in marshes in Italy and India, with bladders like utricularia, but in bunches.

ALE-*conner*, an officer in London, who inspects the measures of public-houses. They are four in number, and chosen by the common-hall of the city.

ALECTRA, in botany, a genus of the didydamia angiosperma class and order, of which there is a single species only, viz. A. capensis, a native of the Cape of Good Hope, found in grassy places near rivers, flowering in November and December.

A-LEE, in sea-language, a term only used when the wind, crossing or flanking the line of a ship's course, presses upon the masts and sails so as to make her incline to one side, which is called the lee-side: Hence, when the helm is moved over to this side, it is said to be *a-lee* or *hard-a-lee*

ALEMBIC, a vessel formerly used in distilling. They were usually made of glass or copper. The bottom, which contained the subject for distillation, was called, from its shape, the cucurbit; the upper part, which received and condensed the stream, was called the head, the beak being fitted into the neck of a receiver. Retorts, and the common worm-still, are now more generally employed.

ALETRIS, in botany, a genus of the monogynia order, and hexandria class of plants; and in the natural method ranking under the tenth order, coronariæ. There are nine species, viz. 1. A. farinosa, or American aletris. 2. A. capensis, a native of the Cape of Good Hope. 3. A. hyacinthoides. 4. A. Zeylanicia, or Ceylon aloe. 5. A. fragrans, or true aloe. 6. A. glauca, a native of the Cape. 7. A. uvaria, or great orange flowered aloe. 8. A. pumila. 9. A. Conchinchensis.

ALEXANDRIAN *manuscript*, a famous copy of the New Testament. This MS. is now preserved in the British Museum. It was sent as a present to king Charles I. from Cyrillus Lucaris, patriarch of Constantinople, by Sir Thomas Rowe, ambassador from England to the Grand Signior, about the year 1628. Cyrillus brought it with him from Alexandria, where probably it was written. In a schedule annexed to it, he gives this account: That it was written, as tradition informed him, by Thecla, a noble Egyptian lady, about 1300 years ago, not long after the council of Nice. But this high antiquity, and the authority of the tradition to which the patriarch refers, have been disputed; nor are the most accurate biblical writers agreed about its age.

A fac simile of this valuable work was published in 1786 by Dr. Woride, with types cast on purpose.

ALGÆ, Flags, one of the seven families, or natural tribes, into which the whole vegetable kingdom is divided by Linnæus, in his Philosophia Botanica. They are defined to be plants, whose root, leaf, and stem, are all one. Under this description are comprehended all the seaweeds, and some other aquatic plants. In the sexual system they constitute the third order of the twenty-fourth class *cryptogamia*, and the fifty-seventh order in Linnæus's Fragment of a Natural Method.

ALGEBRA. The term Algebra, although evidently Arabic, seems to be of rather uncertain derivation, the most probable supposition is, that it is derived from *al* and *geber*, which, when joined, signifies *the reduction of fractions to a whole number*. It is however, applied by the moderns, to express the process of that particular branch of the science of mathematics which teaches the method of performing calculations by means of the letters of the alphabet, together with a few other symbols, which will be explained in the following definitions.

To give here an enlarged view of even the rudiments of Algebra, would be inconsistent with our plan; at the same time, it will be necessary to enter so far into it, as to enable the student to consult, with advantage, the most modern and popular treatises on this important branch of mathematical science.

DEFINITIONS.

1. Known quantities are generally represented by the first letters of the alphabet, as, a, b, c, &c. Unknown, by the last; as, x, y, z.

2. The sign $+$ (*plus* or more) is the mark of addition. Thus, $a+b$ means that the quantities represented by a and b are to be added together. When no sign is prefixed, $+$ is understood.

3. The sign $-$ (*minus* or less) denotes subtraction; as $a-b$, that is, the number represented by b is to be subtracted from that represented by a.

4. Quantities with the sign $+$ prefixed, are called positive or affirmative; and those with the sign $-$ negative quantities.

The sign $\times$ (or, multiplied by) denotes multiplication: as 5×4 means that 5 is to be multiplied by four.

6. $\div$ is the mark of division; thus, $a\div b$ means that a is divided by b.

7. A number prefixed to a letter is called a numeral coefficient. When no number is expressed, 1 is understood.

8. A simple quantity consists of one part or term; as $+a$, $-abc$; a compound quantity of more than one, connected by the signs $+$ or $-$; as, $a+b$, $a-b+c$, are compound quantities. If there are two terms, it is called a *binomial*, if three, a *trinomial*, &c.

9. Like quantities consist of the same letters repeated: thus $+ab$, $-5ab$, are like quantities; but $+ab$, and $+a^2b$ are unlike quantities.

10. The powers of algebraic quantities are expressed by placing a *small figure* (equivalent to the number of factors, and called the index or exponent of the power) at the right hand side of the letter. Thus $a\times a$, or the square of a is expressed by a^2; $b\times b\times b$, or the cube of b, is expressed by b^3; $x\times x\times x\times x$, or the fourth power of x, is expressed by x^4; $\overline{a+b}\times\overline{a+b}\times\overline{a+b}$, or the cube of $a+b$, is expressed by $\overline{a+b}|^3$, and so on.

11. The *roots* of quantities are expressed by the sign $\surd$, with the proper index annexed: thus $^2\surd a$, or $\surd\overline{a}$ expresses the square root of a; $^3\surd b$, the cube root of b; $^4\surd\overline{a+x}$, expresses the biquadrate root of $a+x$, &c.

12. The sign $=$ placed between two or more quantities, expresses the *equality* of such quantities; thus, $a+b=c+d$, means that $a+b$ is equal to $c+d$; and $ax+by=cx+dy=ex+fy$, mean that the quantities $ax+by$, $cx+dy$, and $ex+fy$, are all equal to each other.

13. In algebraical operations the word *therefore*, or *consequently*, often occurs. To express this word the symbol $\therefore$ is commonly used; thus, the sentence; "therefore, $a+b$ is equal to $c+d$," is expressed by $\therefore a+b=c+d$.

14. The symbol $>$ placed between two unequal quantities signifies that the first is greater than the last, thus $a>b$, intimates that a is greater than b; but when the character is inverted, it signifies, that the first quantity is less than the second; thus $a<b$, intimates that a is less than b.

ADDITION.

Case 1. To add quantities that are alike, and have like signs.

Rule. Add the coefficients together, to their sum join the quantities, and prefix the common sign.

$$\begin{array}{rr}
\text{Ex. 1.} & \text{Ex. 2.} \\
2x+3a-4b & 7x^2+3xy-5bc \\
3x+2a-5b & 9x^2+2xy-7bc \\
4x+8a-7b & 11x^2+5xy-4bc \\
9x+4a-6b & x^2+4xy-bc \\
\underline{5x+7a-9b} & \underline{x^2+9xy-2bc} \\
23x+24a-31b & 29x^2+23xy-19bc
\end{array}$$

Case 2. To add quantities that are like, but have unlike signs.

Rule. Subtract the lesser coefficient from the greater, prefix the sign of the greater to the remainder, and subjoin the common letter or letters.

$$\begin{array}{rr}
\text{Ex. 1.} & \text{Ex. 2.} \\
4x^2-3x+4 & -7ab+3bc-xy \\
-2x^2+x-5 & -ab+2bc+4xy \\
3x^2-5x+1 & 3ab-bc+2xy \\
7x^2+2x-4 & -2ab+4bc-3xy \\
\underline{-x^2-4x+13} & \underline{5ab-8bc+xy} \\
11x^2-9x+9 & -2ab\ \star\ +3xy
\end{array}$$

Case 3. To add terms that are unlike.

Rule. Set them all down one after another with their signs and coefficients

$$\begin{array}{lr}
\text{Ex.} & -3x^2 \\
 & -11x^3 \\
 & 6a^2 \\
 & -7e \\
 & -9b^4 \\
 & \underline{12c} \\
\multicolumn{2}{r}{-3x^2-11x^3+6a^2-7e-9b^4+12c}
\end{array}$$

SUBTRACTION.

General Rule. Change all the signs of the quantities to be subtracted into their contrary signs, and add them to the others by the preceding rules; which will give the difference or remainder.

$$\begin{array}{llr}
\text{Ex. 1.} & \text{From} & 6a-12b \\
 & \text{take} & \underline{-5a-10b} \\
 & \text{Ans.} & 11a-2b \\
\text{Ex. 2.} & \text{From} & 5a^2+4ab-6xy \\
 & \text{take} & \underline{11a^2+6ab-4xy} \\
 & \text{Ans.} & -6a^2-2ab-2xy \\
\text{Ex. 3.} & \text{From} & 4a-3b+6c-11 \\
 & \text{take} & \underline{10x+a-15-2y} \\
 & \text{Ans.} & 3a-3b+6c-10x+2y+4
\end{array}$$

MULTIPLICATION.

Rule for the Signs. If the signs of the two terms are like, that of the product is $+$, but if unlike, it is $-$.

Case 1. To multiply two terms.

Rule. Find the sign of the product by the general rule; then place after it the product of the numeral coefficients, and the letters one after another.

Example.

$$\begin{array}{lll}
\text{Mult.} & a & +5b \\
\text{By} & \underline{b} & \underline{-3c} \\
 & ab & -15bc
\end{array}$$

Case 2. To multiply compound quantities.

Rule. Multiply each term of the multiplicand, by the terms of the multiplier, and collect the products into one sum.

Examples.

$$\begin{array}{ll} \text{Mult.} & 3ab-2ac+d \\ \text{By} & 4a \\ \hline \text{Ans.} & 12a^2b-8a^2c+4ad \end{array}$$

Ex. Mult.

$$\begin{array}{lccccc} & a^2+2ab+b^2 & & & & \\ \text{By} & a^2-2ab+b^2 & & & & \\ \hline & a^4 & +2a^3b & +a^2b^2 & & \\ & & -2a^3b & -4a^2b^2 & -2ab^3 & \\ & & & +a^2b^2 & +2ab^3 & +b^4 \\ \hline \text{Ans.} & a^4 & * & -2a^2b^2 & * & +b^4 \end{array}$$

DIVISION.

The same rule for the signs is to be observed in Division as in Multiplication; that is, if the signs of the dividend and divisor are like, the sign of the quotient must be +; if they are unlike, the sign of the quotient must be —. This will be easily deduced from the rule in Multiplication, if you consider that the quotient must be such a quantity as, multiplied by the divisor, shall give the dividend.

The general rule in Division is, to place the dividend above a small line, and the divisor under it, expunging any letters that may be found in all the quantities of the dividend and divisor, and dividing the co-efficients of all the terms by any common measure. Thus, when you divide $10ab+15ac$ by $20ad$, expunging a out of all the terms, and dividing all the co-efficients by 5, the quotient is $\frac{2b+3c}{4d}$.

Powers of the same root are divided by subtracting their exponents, as they are multiplied by adding them. Thus, if you divide a^5 by a^2, the quotient is a^{5-2}, or a^3. And b^6 divided by b^4, gives b^{6-4}, or b^2; and a^7b^5 divided by a^2b^3, gives a^5b^2 for the quotient.

If the quantity to be divided is compound, then you must range its parts according to the dimensions of some one of its letters, as in the following example. In the dividend $a^2+2ab+b^2$, they are ranged according to the dimensions of a, the quantity a^2, where a is of two dimensions, being placed first, $2ab$, where it is of one dimension, next, and b^2, where a is not at all, being placed last. The divisor must be ranged according to the dimensions of the same letters; then divide the first term of the dividend by the first term of the divisor, and set down the quotient, which in this example is a; then multiply this quotient by the whole divisor, and subtract the product from the dividend, and the remainder will give a new dividend, which in this example is $ab+b^2$.

Ex. 1. If $a^2-2ab+b^2$ be divided by $a-b$, the operation will be as follows:

$$\begin{array}{rl} a-b) & a^2-2ab+b^2\ (a-b \\ & a^2-ab \\ \hline & \quad -ab+b^2 \\ & \quad -ab+b^2 \\ \hline & \quad\ \ * \quad\ * \end{array}$$

Ex. 2.

$$\begin{array}{rl} 1-x) & 1 \quad (1+x+x^2+x^3+\&c.+\frac{\text{Remainder}}{1-x} \\ & 1-x \\ \hline & \ +x \\ & \ +x-x^2 \\ \hline & \qquad +x^2 \\ & \qquad +x^2-x^3 \\ \hline & \qquad\qquad +x^3 \\ & \qquad\qquad +x^3-x^4 \\ \hline & \qquad\qquad\qquad +x^4,\ \&c. \end{array}$$

Ex. 3.

$$\begin{array}{rl} y-1) & y^3-1\ (y^2+y+1 \\ & y^3-y^2 \\ \hline & \quad +y^2+1 \\ & \quad\ \ y^2-y \\ \hline & \qquad +y-1 \\ & \qquad\ \ y-1 \\ \hline & \qquad\quad * \end{array}$$

FRACTIONS.

PROB. 1. *To reduce a Mixed Quantity to an Improper Fraction.*

RULE. Multiply the part that is an integer by the denominator of the fractional part; and to the product add the numerator; under their sum place the former denominator.

Thus $2\frac{3}{5}$, reduced to an improper fraction, gives $\frac{13}{5}$; $a+\frac{a^2}{b}=\frac{ab+a^2}{b}$; and $a-x+\frac{a^2-ax}{x}=\frac{a^2-x^2}{x}$.

PROB. 2. *To reduce an Improper Fraction to a Mixed Quantity.*

RULE. Divide the numerator of the fraction by the denominator, and the quotient shall give the integral part; the remainder set over the denominator shall be the fractional part.

Thus, $\frac{12}{5}=2\frac{2}{5}$; $\frac{ab+a^2}{b}=a+\frac{a^2}{b}$; $\frac{ax+2xx}{a+x}=x+\frac{x^2}{a+x}$; $\frac{aa+xx}{a-x}=a+x+\frac{2xx}{a-x}$.

PROB. 3. *To reduce Fractions of different Denominators, to Fractions of equal Value that shall have the same Denominator.*

RULE. Multiply each numerator, separately taken, into all the denominators but its own, and the products shall give the new numerators. Then multiply all the denominators into one another, and the product shall give the common denominator. Thus,

The fractions $\frac{a}{b}$, $\frac{b}{c}$, $\frac{c}{d}$, are respectively equal to these fractions, $\frac{acd}{bcd}$, $\frac{b^2d}{bcd}$, $\frac{c^2b}{bcd}$, which have the same denominator bcd. And the fractions $\frac{2}{3}$, $\frac{3}{4}$, $\frac{1}{5}$, are respectively equal to these $\frac{40}{60}$, $\frac{45}{60}$, $\frac{12}{60}$.

PROB. 4. *To add and Subtract Fractions.*

RULE. Reduce them to a common denominator, and add or subtract the numerators; the sum or difference set over the common denominator, is the sum or remainder required.

Thus, $\frac{a}{b}+\frac{c}{d}+\frac{d}{e}=\frac{ade+bce+d^2b}{bde}$; $\frac{a}{b}-\frac{c}{d}=\frac{ad-bc}{bd}$; $\frac{2}{3}+\frac{3}{4}=\frac{8+9}{12}=\frac{17}{12}=1\frac{5}{12}$; $\frac{3}{4}-\frac{2}{3}=\frac{9-8}{12}=\frac{1}{12}$; $\frac{4}{5}-\frac{3}{4}=\frac{16-15}{20}=\frac{1}{20}$; $\frac{x}{2}-\frac{x}{3}=\frac{3x-2x}{6}=\frac{x}{6}$.

PROB. 5. *To Multiply Fractions.*

RULE. Multiply their numerators one into another to obtain the numerator of the product; and their denominators multiplied into one another, shall give the denominator of the product.

Thus, $\frac{a}{b}\times\frac{c}{d}=\frac{ac}{bd}$; $\frac{2}{3}\times\frac{4}{5}=\frac{8}{15}$.

PROB. 6. *To Divide Fractions.*

RULE. Multiply the numerator of the divi-

dend by the denominator of the divisor, their product shall give the numerator of the quotient. Then multiply the denominator of the dividend by the numerator of the divisor, and their product shall give the denominator. Thus,

$$\frac{4}{5}\Big)\,\frac{2}{3}\,\Big(\frac{10}{12};\quad \frac{3}{7}\Big)\,\frac{5}{8}\,\Big(\frac{35}{24};\quad \frac{c}{d}\Big)\,\frac{a}{b}\,\Big(\frac{ad}{cb};$$

$$\frac{a+b}{a+b}\Big)\,\frac{a-b}{a}\,\Big(\frac{a^2-2ab+b^2}{a^2+ab}$$

Prob. 7. *To find the greatest common measure of two numbers.*

Rule. Divide the greater number by the less, and the last divisor by the last remainder; continue this process until nothing remains, and the divisor last used will be the common measure required.

Thus, to find the greatest common measure of a^2-b^2 and $a^2-2ab+b^2$,

$$a^2-b^2)\ a^2-2ab+b^2\ (1$$
$$\underline{a^2-b^2\qquad\qquad}$$
$$-2ab+2b^2 \text{ remainder,}$$

which divided by $-2b$ is reduced to

$$a-b)\ a^2-b^2\ (a+b$$
$$\underline{a^2-b^2}$$
$$*\quad *$$

Therefore $a-b$ is the greatest common measure required.

Prob. 8. *To reduce a fraction to its lowest terms.*

Rule. Find the greatest common measure by the last problem. Divide both terms of the fraction by the common measure thus found, and it will reduce it to its lowest terms.

Thus $\frac{a}{b}$ being given, and it being required to reduce it to an equal fraction whose denominator shall be c; find the quotient of ac divided by b, and it shall be the numerator of the fraction required.

INVOLUTION.

Involution is the raising of any quantity to a given power, and is performed by continual multiplications of that quantity into itself, till the number of factors amounts to the number of units in the index of the given power.

Thus, the *square* of $a = a^2 = a\times a$: the *cube* of $b = b^3 = b\times b\times b$; the *fourth* power of $2 = 2\times2\times2\times2 = 16$; *the fifth* power of $3 = 3\times3\times3\times3\times3 = 243$.

If the quantity proposed be a compound one, the involution may either be represented by the proper index, or it may actually take place.

Let $a+b$ be the quantity to be raised to any power.

$$\begin{array}{rl}
 & a+b \\
 & \underline{a+b\qquad} \\
 & a^2+ab \\
 & \quad\ \underline{+ab+b^2} \\
\overline{a+b}|^2 \text{ or } & a^2+2ab+b^2 \text{ the sq. or } 2^{d} \text{ power} \\
 & \underline{a+b\qquad\qquad} \\
 & a^3+2a^2b+ab^2 \\
 & \quad\ \underline{+\ a^2b+2ab^2+b^3} \\
\overline{a+b}|^3 \text{ or } & a^3+3a^2b+3ab^2+b^3 \text{ the } 3^{d} \text{ power} \\
 & \underline{a+b\qquad\qquad\qquad\qquad} \\
 & a^4+3a^3b+3a^2b^2+ab^3 \\
 & \quad\ \underline{+\ a^3b+3a^2b^2+3ab^3+b^4} \\
\overline{a+b}|^4 \text{ or } & a^4+4a^3b+6a^2b^2+4ab^3+b^4
\end{array}$$

the fourth power

EVOLUTION.

Evolution, is the reverse of involution, or it is the method of finding the square root, the cube root, &c. of any given quantity, whether simple or compound.

The roots of single quantities are easily extracted by dividing their exponents by the number that denominates the root required. Thus, the square root of a^4 is $a^2 = a^{\frac{4}{2}}$; and the square root of $a^4\,b^6\,c^2$ is $a^2\,b^3\,c$. The cube root of $a^6\,b^3$ is $a^{\frac{6}{3}}\,b^{\frac{3}{3}} = a^2\,b$; and the cube root of $x^9\,y^6\,z^{12}$ is $x^3\,y^2\,z^4$. The ground of this rule is obvious from the rule for Involution.

To extract the root of a compound quantity.

Rule. Range the quantity according to the power of some letter, as in division. Find the root of the first term, and set it in the quotient. Subtract the square of the root thus found from the first term, and bring down the next two terms to the remainder for a dividend, and take double the root already found for a divisor. Divide the dividend by the divisor, and annex the result both to the quotient and the divisor. Multiply the divisor thus increased by the term last put in the quotient, subtract the product from the dividend, and bring down the next two terms to the remainder; proceed thus until the work is finished.

Examples.

Required the square root of $a^2+2ab+b^2$

$$\begin{array}{rl}
 & a^2+2ab+b^2\ (a+b \\
 & \underline{a^2\qquad\qquad} \\
2a+b) & 2ab+b^2 \\
 & \underline{2ab+b^2} \\
 & *\quad *
\end{array}$$

Required the square root of $a^2+2ab+b^2+2ac+2bc+c^2$.

$$\begin{array}{rl}
 & a^2+2ab+b^2+2ac+2bc+c^2\ (a+b+c \\
 & \underline{a^2\qquad\qquad\qquad\qquad} \\
2a+b) & 2ab+b^2 \\
 & \underline{2ab+b^2} \\
2a+2b+c) & *\qquad * \quad 2ac+2bc+c^2 \\
 & \qquad\qquad\ \ \underline{2ac+2bc+c^2} \\
 & \qquad\qquad\quad *\quad *\quad *
\end{array}$$

Required the square root of $a^2-ax+\frac{x^2}{4}$

$$\begin{array}{rl}
 & a^2-ax+\frac{x^2}{4}\Big(a-\frac{x}{2} \\
2a-\frac{x}{2}\Big) & -ax+\frac{x^2}{4} \\
 & -ax+\frac{x^2}{4}
\end{array}$$

To extract any root of any compound quantity

Rule. Find the root of the leading term and place it in the quotient, and bring down the second term for a dividend. Involve the root last found to the power next below that whose root is to be found, and multiply it by the index of the given power for a divisor. Divide the dividend by the divisor for a new term in the root. Involve the whole root, and subtract and divide as before; proceed in this manner till the work is finished.

Example.

Required the square root of $a^4-2a^3b+3a^2b^2-2ab^3+b^4$.

$$\begin{array}{l} a^4-2a^3b+3a^2b^2-2ab^3+b^4(a^2-ab+b^2 \\ a^4 \\ \overline{2a^2)-2a^3b} \\ \quad \underline{a^4-2a^3b+a^2b^2=(a^2-ab)^2} \\ \qquad 2a^2)2a^2b^2 \\ \overline{a^4-2a^3b+3a^2b^2-2ab^3+b^4=(a^2-ab+b^2)^2} \end{array}$$

Therefore a^2-ab+b^2 is the root required.

PROPORTION.

The first relation of quantities is expressed by their arithmetical ratio: the second by their geometrical ratio. That term whose ratio is enquired into is called the antecedent; and that with which it is compared is called the consequent.

Then, of four quantities, the difference between the first and second is equal to the difference between the third and fourth, those quantities are called arithmetical proportionals; as the numbers 3, 7, 12, 16; and the quantities a, $a+b$, e, $e+b$. But quantities form a series in arithmetical proportion when they increase, or decrease by the same constant difference; as these, 1, 2, 3, 4; 10, 7, 4, 1; and a, $a+b$, $a+2b$, $a+3b$, $a+4b$, &c.

In four quantities arithmetically proportional, the sum of the extremes is equal to the sum of the mean terms; as in the arithmetical proportionals a, $a+b$, e, $e+b$, the sum of the extremes $a+e+b=$ to the sum of the mean terms $a+b+e$; therefore, to find the fourth arithmetical proportional, add the second and third quantities, and from the sum, substract the first term which will give the proportional sought.

If, of four quantities the quotient of the first and second be equal to that of the third and fourth, those quantities are then said to be in geometrical proportion; as 2, 6, 4, 12; and the quantities a, ax, b, bx, which are expressed after this manner.

$$\begin{array}{c} 2:6::4:12. \\ a:ax::b\cdot bx \end{array}$$

In four geometrical proportionals the product of the extremes is equal to the product of the middle terms; thus, $a+bx=ax+b$.

When a fourth proportional to any three given quantities is to be found, multiply the second by the third, and divide the product by the first, and the quotient will be the proportional required. Thus to find a fourth proportional to a, ar, and b; the process is $ar+b=arb$, and $arb\div a=br$ the proportional sought.

When a series of quantities increase by a common multiplicator, or decrease by a common divisor, they are said to be in geometrical proportion continued: as

$$a,\ ar,\ ar^2,\ \&c.\ \text{or}\ a,\frac{a}{r},\ \frac{a}{r^2},\ \&c.$$

The common multiplier or divisor, is called the common ratio.

In this kind of series the product of the first and fourth is equal to the product of the second and last but one, or to the product of any two terms equally remote from the extremes.

The sum of a series of geometrical proportionals wanting the first term, is equal to the sum of all but the last term multiplied by the common ratio.

EQUATIONS.

1. An equation is a proposition stating the quality of two quantities by placing the sign $=$ between them.

2. Equations containing only one unknown quantity and its powers, are divided into *orders* according to the highest power of the unknown quantity to be found in any of its terms.

$$\left.\begin{array}{l}\text{If the highest}\\ \text{power of the}\\ \text{unknown quantity in any term}\\ \text{be the}\end{array}\right\}\left\{\begin{array}{c}\text{1st,}\\ \text{2d,}\\ \text{3d,}\\ \text{\&c,}\end{array}\right\}\left\{\begin{array}{c}\text{the}\\ \text{equation is}\\ \text{called}\end{array}\right\}\left\{\begin{array}{c}\text{simple,}\\ \text{quadratic;}\\ \text{cubic,}\\ \text{\&c.}\end{array}\right.$$

But the exponents of the unknown quantities are supposed to be integers, and the equation to be cleared of fractions in which the unknown quantity or any of its powers enters the denominators, thus $x+a=\frac{3x-b}{c}$ is a simple equation; $3x-\frac{b}{2x}=12$, when cleared of the fraction by multiplying both sides by $2x$ is $6x^2-5=24x$ or a quadratic: $x^3-x^4=x^6-20$ which is an equation of the sixth order, &c.

To resolve an equation is to find the value of an unknown term, in those which are known.

Of simple equations and their resolutions.

Rule 1. Any quantity may be transposed from one side of an equation to the other by changing its sign.

Thus if $3x-10=2x+5$
Then $3x-2x=10+5$, or $x=15$.
And $5x+b=a+2x$

By transposing $3x=a-b$.

For equal quantities are here added to, or subtracted from, both sides.

Corollary. The signs of the terms of an equation may be changed to the contrary, and the equation still be true.

Rule 2. Any quantity by which the unknown quantity is multiplied may be taken away, by dividing all the other quantities of the equation by it thus

$$\text{If } ax=b$$
$$x=\frac{b}{a}.$$
$$\text{Also if } mx+nb-am$$
$$x+\frac{nb}{m}=a$$

For if equal quantities are divided by the same quantity, the quotients will be equal.

Rule 3. If the term of an equation be fractional, its denominator may be taken away by multiplying the other terms by it: thus

$$\text{If } \frac{x}{a}=b+c$$
$$x=ab+ac.$$
$$\text{And if } a-\frac{b}{a}=c$$
$$ax-b-cx;\ \text{and, by transposing,}$$
$$ax-cx=b;\ \text{and, by division, } x=\frac{b}{a-c}.$$

For by multiplying all the terms of the equation by the same quantity, the quantities on each side are equal.

Coroll. If any quantity on both sides of the equation have the same sign, it may be taken from both. And if all the terms in an equation are multiplied or divided by the same quantity, it may be taken away from all of them: *e.*

If $3x+a=a+b$, then $3x=b$.

If $2ax+3ab=ma+a^2$, then $2x+3b=m+a$.

If $\frac{x}{3}-\frac{4}{3}=\frac{16}{3}$, then $x-4=16$.

Hereby the unknown term may be separated from the known, and the equation is resolved.

Examples of simple equations solved by these rules.

$$\text{If } 3x+5=x+9$$
$$2x=4$$

$$\text{If } 5x-\frac{5x}{2}+12=\frac{4x}{3}+26$$
$$5x-\frac{5x}{2}-\frac{4x}{3}=26-12-14$$
$$30x-15x-8x=84$$
$$\text{or } 7x=84$$
$$x=\frac{84}{7}=12.$$

$$\text{If } \frac{5}{x}+\frac{9}{4}=16$$
$$\frac{20}{x}+9=64$$
$$20+x9=64$$
$$20=64x-9x=55x$$
$$20 \quad 4$$

Solution of questions producing simple equations.

General Rule. Express the unknown quantities by letters, and the relations between the known and unknown, or, as they are called, the conditions, by equations, which being resolved, give the answer.

Example. If the question is concerning two numbers, they may be called x and y, and the conditions from which they are to be investigated must be expressed by equations: thus

If it be required that the sum of two numbers sought be 60, that condition is thus expressed } $x+y=60$.

If their difference must be 24 then $x-y=24$.

If their product is to be 96 then $xy=96$

If their quotient is to be 6, then $\frac{x}{y}=6$.

Case 1. When only one unknown quantity is to be found.

Rule. An equation involving the unknown quantity must be deduced from the question; and when there is but one unknown quantity, there can be but one independent equation in the question.

Ex. 1. To find a number to which if there be added a half, a third, and a fourth of itself, the sum will be 50.

Represent the unknown quantity by z, then half of it is $\frac{z}{2}$, a third $\frac{z}{3}$, &c. Therefore,

$$z+\frac{z}{2}+\frac{z}{3}+\frac{z}{4}=50.$$
$$24z+12z+8z+6z=1200$$
$$50z=1200$$
$$z=24$$

Ex. 2. A and B began to trade with equal stocks: A gained 200*l.* and B lost 100*l.* after which, A's stock was to B's as three to two. What did each begin with?

Let x = pounds each began with; then $x+200$ = A's stock increased by 200, and $x-100$ = B's diminished by 100. Now $x+200 : x-100 :: 3 : 2$. Then $2x+400=3x-300$ by mult. extremes and means. And $400=x-300$ by transposing $2x$: also $700=x$ by transp. -300. Therefore each began with 700*l.*

Case 2. When there are two unknown quantities.

Rule. Two independent equations involving the two unknown quantities, must be derived from the question. A value of one of the quantities must be derived from each of the equations; and the two values being put equal to each other, a new equation will be formed, involving only one unknown quantity.

Ex. A says to B, seven years ago I was three times as old as you were, and seven years hence I shall be twice as old as you will be. What are their present ages?

Let the ages of A and B be x and y, then seven years ago their ages were $x-7$ and $y-7$, and seven years hence they will be $x+y$ and $y+7$:

therefore, $x-7=3\times\overline{y-7}=3y-21$

$$x+7=2\times\overline{y+7}=2y+14$$
$$x=3y-14$$
$$x=2y+7$$
$$3y-14=2y+7$$
$$y=21\text{, the age of B}$$
$$x=49\text{, the age of A}$$

Case 3. When there are three or more unknown quantities.

Rule. In this case there must be three independent equations arising from the question, from each of which a value of one of the unknown quantities must be obtained: then by comparing these three values, two equations will arise involving only two unknown quantities. In like manner the rule may be extended to four or more unknown quantities.

Ex. To find three numbers, so that the first with half the other two, the second with one third of the other two, and the third with one-fourth of the other two, may each be equal to 34.

Let the numbers be x, y, z, and the equations are,

$$x+\frac{y+z}{2}=34$$
$$y+\frac{x+z}{3}=34$$

$z+\frac{x+y}{4}=34$; then by the first equation

$x=\frac{68-y-z}{2}$; and by the second

$x=102-3y-2$; and by the third

$x=136-4z-y$; therefore

$$\frac{68-y-z}{2}=102-3y-z$$

$y=\frac{136-z}{5}$; and by the two latter equations

$y=\frac{3z-34}{}$ therefore

$$3z-34 \quad 136-z$$

$$15z-170=272-2z$$
$$17z=442 \text{ or } z=26$$
$$y=22\text{, and } x=10.$$

General Solution of Problems.

In the solutions of the preceding questions

the given quantities, being numbers, disappear in the last conclusion, so that no general rules for like cases can be deduced from them But if letters are used to denote both the known and unknown quantities, a general solution may be obtained, because, during the whole operation, they retain their original form; whence the connection of the quantities will plainly discover the limits of the data, which is necessary to the perfect solution of a problem.

Ex. To find two numbers, of which the sum and difference are given.

Let s be the sum given, and d the difference; and let x and y be the numbers sought. Then

$$x+y=s$$
$$x-y=d$$
$$\text{Whence}\begin{cases}x=s-y\\x=d+y\end{cases}$$
$$d+y=s-y$$
$$2y=s-d$$
$$y=\frac{s-d}{2}$$
$$\text{And } x=\frac{s+d}{2}.$$

Equations are either pure or adfected.

Of Pure Equations.

A pure equation is that in which only one power of the unknown quantity is found.

Rule. Make the power of the unknown quantity stand alone, then extract the root of the same denomination out of both sides, and this will give the value of the unknown quantity.

Example.

$$\text{If } a^2+ax^2=b^3$$
$$ax^2=b^3-a^2$$
$$x^2=\frac{b^3-a^2}{a}$$
$$x=\sqrt{b^3-a^2}$$

Of Adfected Quadratic Equations.

An adfected equation is that in which different p[illegible] of the unknown quantity fou[illegible] the several terms. An adfected quadratic equation (commonly called a quadratic) involves both the unknown quantity and its square.

Rule. 1. Transpose the terms involving the unknown quantity to one side, and the known terms to the other; so that the term containing the square may be positive.

2. If the square of the unknown quantity be multiplied by any coefficient, divide all the terms of the equation by it, so that the coefficient of the square of the unknown quantity may be 1.

3. Add to both sides the square of half the [illegible]fficient of the unknown quantity, and the side of the equation involving the unknown quantity will be a complete square.

4. Extract the square root from both sides of the equation, and by transposing the half-coefficient just mentioned, a value of the unknown quantity will be had in known terms. The different forms of quadratic equations expressed in general terms, being reduced by the first and second parts of the rule are these

1. $x^2+ax=b^2$
2. $x^2-ax=b^2$
3. $x^2-ax=-b^2$.

Case 1. $x^2+ax=b^2$

$$x^2+ax+\frac{a^2}{4}=b^2+\frac{a^2}{4}$$
$$x+\frac{a}{2}=\pm\sqrt{b^2+\frac{a^2}{4}}$$
$$\sqrt{b^2+\frac{a^2}{4}}-\frac{a}{2}.$$

Case 2. $x^2-ax=b^2$

$$x^2-ax+\frac{a^2}{4}=b^2+\frac{a^2}{4}$$
$$x-\frac{a}{2}=\pm\sqrt{b^2+\frac{a^2}{4}}$$
$$x=\frac{a}{2}\pm\sqrt{b^2+\frac{a^2}{4}}$$

Case 3. $x^2-ax=-b^2$

$$x^2-a^2+\frac{a^2}{4}=\frac{a^2}{4}-b^2$$
$$x-\frac{a}{2}=\pm\sqrt{\frac{a^2}{4}-b^2}$$
$$x=\frac{a}{2}\pm\sqrt{\frac{a^2}{4}-b^2}.$$

1. Every quadratic equation will have two roots, except those of the third form, whose roots become impossible. 2. In the two first forms, one of the roots must be positive, and the other negative. 3. In the third form, if $\frac{a^2}{4}$ or the square of half of the coefficient of the unknown quantity be greater than b^2, the known quantity, the two roots will be positive If $\frac{a^2}{4}$ be equal to b^2, the two roots become equal; but if $\frac{a^2}{4}$ is less than b^2, the quantity under the radical sign will be negative, and the two roots are impossible. 4. If the equation express the relation of magnitudes abstractedly, where a contrariety cannot be supposed to take place, there are no negative roots.

Solution of questions producing quadratic Equations.

The operation till we arrive at a quadratic equation, is the same as in the solution of simple equations.

Examples. One lays out a certain sum in goods, which he sells again for 24*l.* and gains as much per cent. as the goods cost him. What was the cost?

If the money laid out be 1 | y

The gain will be 2 $24-y$

But this gain is $y:\ 24-y::100$ 3 $\frac{2400-100y}{y}$ per cent

Therefore by question $y=\frac{2400-100y}{y}$

And by mult. & trans. $y^2+100y=2400$

Completing the sqr. $y^2+100y+50^2=2400+2500=4900$

Extract the root $y+50=\pm\sqrt{4900}=70$

Transpose $y=\pm70-50=20$ or -120

The answer is 20*l.* the other root -120 being negative, is impossible.

Of indeterminate Problems.

If there are more unknown quantities in a question than equations, by which their relations are expressed, it is indetermined.

Example. To divide a given square number into two parts, each of which shall be a square number.

Here are two quantities sought, and only one equation expressing their relation; but it is also required that they may be rational, which cannot be expressed by an equation; therefore another condition must be assumed so as to obtain a solution in rational numbers.

Let the given square be a^2; let one of the squares sought be x^2, the other is a^2-x^2. Let $rx-a$ also be a side of the last square, therefore

$$r^2x^2-2rxa+a^2=a^2-x^2$$

By transp. $r^2x^2+x^2=2rxa$

Divide by x $r^2x+x=2ra$

Therefore $=\frac{2ra}{r^2+1}$

And $rx-a=\frac{2r^2a}{r^2+1}-=\frac{r^2-1}{r^2+1}a.$

Let r therefore be assumed at pleasure, and $\frac{2ra}{r^2+1}$, $\frac{r^2-1}{r^2+1}a$, which must always be rational, will be the sides of the two squares required.

Thus, if $a^2=100$; then, if $r=3$, the sides of the two squares are 6 and 8, for $36+64=100$.

Also, let $a^2=64$. Then, if $r=2$, the sides of the squares are $\frac{32}{5}$ and $\frac{24}{5}$; and $\frac{1024}{25}+\frac{576}{25}=\frac{1600}{25}=64$.

The reason of the assumption of $rx-a$ as a side of the square a^2-x^2, is, that being squared and put equal to this last, the equation manifestly will be simple, and the root of such an equation is always rational.

Of the origin and composition of Equations, and of the Signs and Coefficients of their Terms.

The higher order of equations and their general affections, are best investigated by considering their origin from the combination of inferior equations. Now all the terms of any equation are brought to one side, and the equation is expressed by making them equal to 0. Therefore if a root of the equation be inserted instead of the unknown quantity, the positive terms will be equal to the negative, and the whole equal to 0.

Def. When an equation is put into this form, the term in which the unknown quantity (x) is of the highest power, made the first, that in which the index of x is less by 1, the second, and so on till the last into which the unknown quantity does not enter, and which is called the absolute term.

Prop. I. If any number of equations be multiplied together, an equation will be produced of which the dimension is equal to the sum of the dimensions of the equations multiplied. If any number of simple equations be multiplied together as $x-a=0$, $x-b=0$, $x-c=0$, &c. the product will be an equation of a dimension containing as many units as there are simple equations. So if higher equations are multiplied together one of a higher order will be produced. *Conversely.* An equation of any dimension is considered as compounded of simple equations or of others the sum of whose dimensions is equal to that of the given one. By the resolution of equations these inferior equations are discovered, and by investigating the component simple equations, the roots of the higher orders are found.

Cor. 1. An equation admits of as many solutions, or has as many roots, as there are simple equations in it.

Cor. 2. Conversely, no equation can have more roots than dimensions.

Cor. 3. Imaginary or impossible roots must enter an equation by pairs, because they arise from quadratics. And an equation of an even dimension may have all its roots, or an even number of them impossible; but an equation of an odd dimension, must have one positive root at least.

Cor. 4. The roots are positive or negative according to the roots of the simple equations.

Cor. 5. When one root of an equation is discovered, one of the simple equations is found; and the given equation being divided by it, will give an equation of a dimension lower by 1.

Prop. II. To explain the general properties of the signs and coefficients of the terms of an equation.

Let $x-a=0$, $x-b=0$, $x-c=0$, the roots are any positive quantities $+a$, $+b$, $+c$, $+d$, &c. And let $x+m=0$, $x+n=0$, &c. be simple equations, whose roots are any negative quantities $-m$, $-n$, and let any number of these equations be multiplied together as in the following table:

$$x-a=0$$

$$\times \quad x-b=0$$

$$\left.\begin{matrix}x^2-ax\\-bx+ab\end{matrix}\right\}=0 \text{ a quadratic.}$$

$$\times\ x-c=0$$

$$=x^3\left.\begin{matrix}-a\\-b\\-c\end{matrix}\right\}\times x^2\ \left.\begin{matrix}+ab\\+ac\\+bc\end{matrix}\right\}\times x-abc=0 \text{ a cubic.}$$

$$\times\ x-m=0$$

$$=x^4\left.\begin{matrix}-a\\b\\-c\\+m\end{matrix}\right\}\times x^3\left.\begin{matrix}+ab\\+ac\\+bc\\-am\\-bm\\-cm\end{matrix}\right\}\times x^2\left.\begin{matrix}-abc\\+abm\\+acm\\+bcm\end{matrix}\right\}\times -abcm=0, \text{ a biquadratic, \&c.}$$

From this it appears: 1. That in a complete equation the terms are always greater by a unit than the dimension of the equation.

2. The coefficient of the first term is 1. The coefficient of the second term is the sum of the roots with their signs changed. The coefficient of the third term is the sum of all the products made by multiplying any two of the roots together. The coefficient of the fourth term is the sum of all the products that can be made by multiplying together any three of the roots with their signs changed.

The last term is the product of all the roots, with their signs changed.

3. From induction it appears that in any equation there are as many positive roots as there are changes in the signs of the terms, and the remaining roots are negative.

Cor. If a term of an equation be wanting, the positive parts of its coefficient are equal. If there is no absolute term, some of the roots $=0$, and the equation may be depressed by dividing all the terms by the lowest power of the unknown quantity in any of them.

Of the Transformation of Equations.

Prop. I. The affirmative roots of an equation become negative, and the contrary by changing the signs of the alternate terms, beginning with the second.

Thus the roots of the equation $x^4-x^3-19x^2-49x-30=0$, are $+1,+2,+3,-5$, but the roots of the equation $x^4+x^3-19x^2-19x-49=-300$, are $-1,-2,-3,+5$.

Prop. II. An equation may be transformed into another having its roots greater or less than the roots of the given equation by a given difference.

Let e be the given difference; then $y=x\pm e$, and $x=y\pm e$; and if for x and its powers in the given equation $y\pm e$ and its powers be inserted, a new equation will arise, in which the unknown quantity is y, and its value will be $x\pm e$.

Let the equation proposed be $x^3-px^2+qx-r=0$, of which the roots must be diminished by e. By inserting for x and its powers $y+e$ and its powers, the equation required is

$$\left.\begin{array}{llll} y^3 & +3ey^2 & +3ey^2 & +e^3 \\ & -py^2 & -2pey & -pe^2 \\ & & +qy & +qe \\ & & & -r \end{array}\right\}=0.$$

Cor. 1. The use of this transformation is to take away the second, or any other intermediate term; for as the coefficients of all the terms of the transformed equation, except the first, involve the powers of e, and known quantities only, by putting the coefficient of any term equal to 0, and resolving that equation, a value of e may be determined, which being substituted, will make that term to vanish.

Cor. 2. The second term may be taken away by the solution of a simple equation, the third by a quadratic, and so on.

Prop. III. An equation may be transformed into any other, whose roots shall be equal to the roots of the given equation multiplied or divided by a given quantity

Ex. Let $y=xe$, or $y=\frac{x}{e}$

Then substitute for x and its powers $\frac{y}{e}$ or ye and its powers, and the new equation will have the property required.

Cor. 1. An equation in which the coefficient of the first term is any unknown quantity, as a, may thus be transformed into another, in which the coefficient of the first term will disappear. Thus let the equation be $ax^3-p^2+9x-r=0$

Suppose $y=ax$, or $x+\frac{y}{a}$ and for x and its powers insert $\frac{y}{a}$ and its powers, and the equation becomes $\frac{y^3}{a^2}-\frac{py^2}{a^2}+\frac{qy}{a}-r=0$, or $y^3-py^2+qay-a^2r=0$.

Cor. 2. Fractions may be taken away from an equation by multiplying the equation by the denominators, and by this proposition the equation may be then transformed into another without fractions, in which the coefficient of the first term is 1.

Cor. 3. And hence if the coefficient of the second term of a cubic equation be not divisible by 3, the fractions thence arising, wanting the second term, may be taken away by the preceding corollary. But the second term may be also taken away, so that there shall be no such fractions in the transformed equation by supposing $x=\frac{z\pm p}{3}$, $\pm p$ being the coefficient of the second term. And if the equation $ax^3-bx^2+qx-r=0$ be given which p is not divisible by 3, by supposing $x=\frac{z+p}{3a}$ the transformed equation reduced is $z^3-\overline{3p^2+9aq}\times z-zp^3+9apq-7a^2r=0$, wanting the second term, having 1 for the coefficient of the term, and the coefficients of the others all integers,

General Corollary to the preceding Propositions.

If the roots of these transformed equations be found by any method, the roots of the original equation will be found from the simple equations expressing their relation.

These principles and operations will supply rules for resolving equations of all orders; and the student who is desirous of more particular information may consult the excellent elementary treatise of the Rev. B. Bridge of Cambridge, Bonnycastle's Algebra, and a recent work by Mr. Peter Nicholson, with others.

ALGOL, a fixed star of the second magnitude in the constellation of Perseus, otherwise called Medusa's head. This star has been subject to singular variations, appearing at different times of different magnitudes, from the fourth to the second, which is its usual magnitude.

ALGORITHM an Arabic word frequently used to denote the practical rules of Algebra, and sometimes also the practice of common arithmetic, in which sense it coincides with with *logistica numeralis*, or the art of numbering truly and readily.

ALIEN, in law, is a person born in a foreign country, not within the king's allegiance, in contradistinction from a denizen or natural subject.

An alien is incapable of inheriting lands in England, till naturalized by an act of parliament. No alien is entitled to vote in the choice of members of parliament, has a right to enjoy offices, or can be returned on any jury, unless where an alien is party in a cause; and then the inquest of jurors shall be one half natives and the other aliens.

ALLIMENTARY *duct*, a name by which some call the intestines on account of the food's passing through them. See ANATOMY.

ALIMONY, *alimonia*, in law, denotes the maintenance sued for by a wife, in case of a separation from her husband, wherein she is neither chargeable with elopement nor adultery

ALIQUANT *parts*, in arithmetic, the which will not divide or measure the whole number exactly. Thus, 7 is an aliquant part

of 16, for twice 7 wants 2 of 16, and three times 7 exceeds 16 by 5.

ALIQUOT *part*, is such part of a number as will divide and measure it exactly, without any remainder. For instance, 2 is an aliquot part of 4, 3 of 9, and 4 of 16.

Aliquot parts must not be confounded with commensurable ones; for though the former be all commensurable, yet these are not always aliquot parts: thus 4 is commensurable with 6, but is not an aliquot part of it.

ALISMA, in botany, the *water plantain*, a genus of plants of the class and order hexandria polyginia. The essential characters are calyx three-leaved; petals three; seeds several. There are nine species, most of which are to be found in England; they are inhabitants of watery places, bogs, &c.

ALKAHEST. The pretended universal solvent, or menstruum of the ancient chemists. Kunckel has very well shown the absurdity of searching for a universal solvent, by asking, "If it dissolve all substances, in what vessels can it be contained?"

ALKALESCENT. Any substance in which alkaline properties are beginning to be developed, or to predominate, is termed alkalescent. The only alkali usually observed to be produced by spontaneous decomposition is the volatile: and from their tendency to produce this, some species of vegetables, particularly the cruciform, are styled alkalescent, as are some animal substances.

ALKALI. A term derived from kali the Arabic name of a plant, from the ashes of which one species of alkaline substance can be extracted. Alkalis may be defined, those bodies which combine with acids, so as to neutralize or impair their activity, and produce salts. Acidity and alkalinity are therefore two correlative terms of one species of combination.

The alkalis may be arranged into three classes: 1*st*, Those which consist of a metallic basis combined with oxygen. These are three in number, potash, soda, and lithia. 2*d*, That which contains no oxygen, viz. ammonia. 3*d*, Those containing oxygen, hydrogen, and carbon.

Besides neutralizing acidity, and thereby giving birth to salts, the first four alkalis have the following properties.—

1st, They change the purple colour of any vegetables to a green, the reds to a purple, and the yellows to a brown. If the purple have been reddened by acid, alkalis restore the purple.

2d. They possess this power on vegetable colours *after* being saturated with carbonic acid, by which criterion they are distinguishable from the alkaline earths.

3d, They have an acrid and urinous taste.

4th, They are powerful solvents or corrosives of animal matter; with which, as well as with oils in general, they combine, so as to produce neutrality.

5th, They are decomposed, or volatilized, at a strong red heat.

6th, They combine with water in every proportion, and also largely with alcohol.

7th, They continue to be soluble in water when neutralized with carbonic acid; while the alkaline earths thus become insoluble.

ALKALIMETER. The name first giv by M. Descroizilles to an instrument for determining the quantity of alkali in the potash of commerce; an instrument on a much more simple principle has recently been invented by Dr. Ure, and is now in general use.

ALLAMANDA, in botany, a genus of the pentandria monogynia class and order: corolla twisted; capsule lens-form, erect, echinate, one-celled, two-valved, many-seeded. One species, viz. cathartica, a climbing plant, found in Guiana. The infusion of its leaves is used in the cholic.

ALLEGIANCE, is the lawful duty from the subject to the sovereign; and is either natural, as every subject born ought to pay; acquired; where a man is naturalized; local, which a man ought to pay who comes under the dominion of the king.

ALLEGORY, in matters of literature, a mode or species of writing, wherein something else is signified than the words in their literal meaning express. An allegory may be considered as a series or chain of metaphors, continued through a whole discourse. For example, when the prophets represent the Jews under the allegory of a vine planted, cultivated and watered by the hand of God which instead producing good fruit, brings forth verjuice and sour grapes.

ALLEGRO, in music, an Italian word denoting that the part is to be played in a sprightly, brisk, lively, and gay manner.

ALLEMAND, a sort of grave solemn music, with good measure and a slow movement. It is also a kind of dance very common in Germany and Switzerland.

ALLIGATION, in arithmetic, is the rule of mixture, which teaches to compound veral species of ingredients or commodities together, according to any intent or design proposed, and is either medical or alternate.

Alligation *medical* shews the rate or price of any mixtures, when the several quantities of the mixture, and their rates, are known.

Alligation *alternate* teaches to mix goods, of different prices, in such proportion, that the mixture may be sold for any price proposed.

ALLITERATION, in rhetoric, is a figure or decoration in language, chiefly used in poetry, and consisting in the repetition of the same letter or letters at certain intervals, whence the name is derived.

ALLIONIA, a genus of plants of the class and order *tetrandria monogynia*. The corolla is one-petalled and funnel shaped; and the essential character is calyx, common, oblong, simple, three-flowered; proper obsolete, superior, corolla irregular; receptacle naked. There are two species, natives of South America.

ALLIUM, Garlick, in botany, a genus of plants, of the hexandria monogynia class and order. The corolla is six-petalled, and the essential character is, cor. six-parted, spreading, spathe many flowered: umbel heaped caps. superior.

This is a very extensive genus of plants, comprehending the A. *porrum* or *leek*: the A. *cepa* or onion, with all their varieties. There are in all 43 species.

ALLODIAL, an epithet given to an inheritance held without any acknowledgement to a lord or superior, in opposition to feudal.

Allodial lands are free lands, for which neither fees, rents, nor services are due.

ALLOY, or **Allay**, a proportion of a baser metal mixed with a finer one. Thus, all gold coin has an alloy of silver and copper, as silver coin has of copper alone; the proportion in the former case, for standard gold, being two carats of alloy in a pound troy of gold; and in the latter 18 pennyweights of alloy for a pound troy of silver.

According as gold or silver has more or less alloy than that mentioned above, it is said to be coarser or finer than the standard. However, it ought to be remarked, that the coin of different nations varies greatly in this respect; some using a larger, and others a less proportion of alloy, the original intention of which was to give the coin a due degree of hardness.

ALLUSION, in rhetoric, a figure by which something is applied to, or understood of another, on account of some similitude between them.

ALLUVIAL *Formations*, in geology, are recent deposits in valleys or in plains, of the *detritus* of the neighbouring mountains. Gravel, loam, clay, sand, brown coal, wood coal, bog iron ore, and calc tuff, compose the alluvial deposits. The gravel and sand sometimes contain gold and tin, if the ores exist in the adjoining mountains. Petrified wood and animal skeletons are found in the alluvial clays and sand.

ALMAGEST, the name of a celebrated book composed by Ptolemy; being a collection of a great number of the observations and problems, of the ancients, relating to geometry and astronomy; but especially the latter. And being the first work of this kind which has come down to us, and containing a catalogue of the fixed stars, with their places, besides numerous records and observations of eclipses, and the motions of the planets.

ALMANAC, a table containing the calendar of days and months, the rising and setting of the sun, the age of the moon, &c. The *Nautical and Astronomical Almanac* is a kind of national almanac, being published under the direction of the commissioners of longitude. This work, in addition to the matter which it contains in common with other almanacs, furnishes the mariner with all the astronomical information connected with navigation.

ALMOND *tree*, in botany, see **Amygdalus**.

ALMUCANTURS, in astronomy, an Arabic word denoting circles of the sphere passing through the centre of the sun, or a star, parallel to the horizon, and are the same as parallels of altitude. They serve to shew the height of the heavenly bodies, and are generally inscribed on quadrants, &c.

ALOES. This is a bitter juice, extracted from the leaves of a plant of the same name. Three sorts of aloes are distinguished in the shops by the names of aloe soccotrina, aloe hepatica, and aloe caballina. The first denomination, which is applied to the purest kind, is taken from the island of Zocotora; the second, or next in quality, is called hepatica, from its liver colour; and the third, caballina, from the use of this species being confined to horses. These kinds of aloes are said to differ only in purity, though, from the difference of their flavours, it is probable that they may be obtained, in some instances, from different species of the same plant. It is certain however, that the different kinds are all prepared at Morviedro, in Spain, from the same leaves of the common aloe.

ALPHABET. *In literature, alphabet signifies the natural or accustomed series of the several letters of a language. The word is derived from* alpha *and* beta, the first two letters in the Greek alphabet. Alphabets of different nations vary in the number of their constituent letters. The English alphabet contains 24 letters, to which if *j* and *v*, consonants, are added, the sum will be 26; the French 23; the Hebrew, Chaldee, Syriac, and Samaritan, 22 each; the Arabic 28; the Persian 31; the Turkish 33; the Georgian 36; the Coptic 32; the Muscovite 43; the Greek 24; the Latin 22; the Sclavonic 27; the Dutch 26; the Spanish 27; the Italian 20; the Ethiopic, as well as Tartarian, 202; the Indian of Bengal 21; the Baramos 19; the Chinese, properly speaking, have no alphabet, except we call their whole language their alphabet; their letters are words, or rather hieroglyphics, and amount to about 80,000.

ALPINIA, a genus of the monandria monogynia class and order. The corolla is monopetalous and tubulose; and the essential character is, calyx three-toothed, equal, tubulose; corolla three-parted, equal; nect. two-lipped, the lower lip spreading.

It derives its name from Prosper Alpinus, a celebrated botanist. There is but one species, a native of the West Indies.

ALSTONIA, a genus of the polyandria monogynia class and order. The corolla is shorter than the calyx; and the essential character is, corrolla one-petalled, eight or ten cleft; the clefts alternated. There is only one species, a shrub of South America, the leaves of which are said to have the taste of tea.

ALSTROEMERIA, in botany, a genus of the hexandria monogynia class and order: corolla six-petalled, somewhat two-lipped; the lower petals tubular at the base; stamina declined. There are six species, all found in South America.

ALT, in music, a term applied to that part of the great scale of sounds which lies between F above the treble-cleft note and G in altissimo.

ALTAR, a place upon which sacrifices were anciently offered to some deity.

The heathens at first made their altars only of turf: in following times they were made of stone, of marble, of wood, and even of horn, as that of Apollo in Delos. Altars differed in figure as well as in materials. Some were round, others square, and some oval. They always fronted east, and were adorned with sculpture, inscriptions, and the leaves and flowers of particular trees sacred to the deity to whom they were raised.

ALTERN *base*, in trigonometry, a term used in contradistinction to the true base. Thus in oblique triangles, the true base is either the sum of the sides, and then the difference of the sides is the altern base; or the true base is the difference of the sides, and then the sum is the altern base.

ALTERNATE, in heraldry, a term used respect to the situation of the quarters. Thus the first and fourth quarters, and the second and third being generally the same, are called alternate quarters *Alternate*, in botany

means that disposition of the leaves of a plant when the first on one side of a branch is higher than the first on the other side, and so on with the rest.

ALTERNATION is used for the different ways which any number of quantities may be changed, or combined. See COMBINATION.

ALTHÆA, MARSH-MALLOW, a genus of plants, with a double calyx, the exterior one being divided into nine segments; the fruit consists of numerous capsules, each containing a single seed. It belongs to the monadelphia polyandria class of Linnæus. The essential character is, calyx double, outer nine-cleft; arils many, one-seeded.

There are seven species, of which the A. officinalis, or common marsh mallow, is well known.

ALTIMETRY, denotes the art of measuring altitudes or heights. See MENSURATION.

ALTITUDE, in geometry, one of the three dimensions of body; being the same with what is otherwise called height.

Altitude of a figure is the distance of its vertex from its base, or the length of a perpendicular let fall from the vertex to the base.

ALTITUDE, in optics, is the height of an object above a line drawn parallel to the horizon from the eye of the observer.

ALTITUDE *of the eye*, in perspective, is its perpendicular height above the geometrical plane.

ALTITUDE *of a star, &c.* in astronomy, is an arch of a verticle circle, intercepted between the stars and the horizon.

This altitude is either true or apparent, according as it is reckoned from the rational or sensible horizon, and the difference between these is what is called by astronomers the parallax of altitude. Sailors generally take the altitude of the sun and stars with a quadrant, but this method is liable to an error, arising from the ship's motion. M. Parent has given a method of taking altitudes by means of a common watch, which is liable to a much less error than that of the quadrant. His method is this: having observed the difference of time between the rising of two stars, the right ascension and declination of which are known from astronomical tables, in the Nautical Almanac, it will be easy to distinguish that part of the difference which arises from that different position, from that arising from the obliquity of the sphere. Now this last is precisely the altitude of the pole of the place of observation; for as to the way the ship may have made between the rising of the two stars, it is so small as to be safely overlooked, or at most estimated in the common way of reckoning.

ALUM, is one of those substances which chemists distinguish by the name of triple salts. It is composed of sulphuric acid, potash, alumina, and water. Alum is of a white colour; it has an astringent and acid taste, and crystalizes in regular octahedrons. From the experiments of several eminent chemists, its specific gravity appears to be 1.731. Water at the temperature of 60 dissolves about one fifteenth of its weight of alum; but boiling water dissolves about three fourths of its weight. When alum is exposed to a dry atmosphere, a slight efflorescence takes place; when heated it speedily becomes liquid. Alum is much used by dyers and others artists in their different processes. The principal alum manufactory in Britain is at Hurlett, near Paisley, on the estate of the earl of Glasgow. The next in magnitude is at Whitby.

ALUMINA. One of the primitive earths, which, as constituting the plastic principle of all clays, loams, and boles, was called argil or the argillaceous earth, but now, as being obtained in greatest purity from alum, is styled alumina. It was deemed elementary matter till Sir H. Davy's celebrated electro-chemical researches led to the belief of its being, like barytes and lime, a metallic oxide. Alumina is widely diffused in nature. It is a constituent of every soil, and of almost every rock. It is the basis of porcelain, pottery, bricks, and crucibles. Its affinity for vegetable colouring matter is made use of in the preparation of lakes, and in the arts of dyeing and calico printing. Native combinations of alumina, constitute the fuller's earth, ochers, boles, pipeclays, &c.

ALURNUS, a genus of insects of the order of cleoptera, with filiform antennæ, six short feelers and a horny arched jaw. There are three species, natives of the Cape of Good Hope, viz. the A. grossus, femoratus, and dentipes.

AMALGAM, a mass of mercury united and incorporated with some other metal.

Amalgams grow soft with heat and hard with cold; and the metals amalgamated with mercury, assume a consistence harder or softer, in proportion to the quantity of mercury employed in the amalgam.

Amalgams are used either to render a metal fit to be extended on some works, as in gilding; or else to reduce the metal into a very subtile powder.

For the composition of amalgam for electrical machines see ELECTRICITY.

AMALGAMATION, in chemistry, the operation of making an amalgam, or of mixing quicksilver with some metal, is performed by fusing, or at least igniting the metal, and in this state adding a proportion of mercury to it; upon which they mutually attract and incorporate with each other.

Of all metals, gold unites with mercury with the greatest facility; next to that, silver; then lead, tin, and every metal, except iron and copper, the last of which incorporates with quicksilver with great difficulty, and the former scarcely at all. An amalgam of tin and mercury is used for looking-glasses. In this case, the glass-plate is laid on an even board, on which is spread very evenly some tin-foil, and on the tin-foil is spread quicksilver: the glass is then laid on the quicksilver, and a number of leaden weights, covered with baize or flannel, are laid upon the glass; in this state it remains several days, till the tin and quicksilver, in the state of amalgam, adhere firmly to the glass, by means of which it acquires the power of reflection.

AMARANTHUS, in botany, the name of a genus of plants, sometimes called prince's feather, the flower of which is rosaceous, and its fruit an oval or roundish capsule, containing only one large seed of a roundish compressed shape. The characters are: the male calyx is a five or three-leafed perianthium, erect, coloured, and persistent: there is no corolla: the stamina consists of five or three erect capillary

filaments, the length of the calyx; the antheræ are oblong and versatile: the female calyx the same as the male, and no corolla: the pistillum has an ovate germen; the styli are three, short and subulated; the stigmata simple and persistent: the pericarpium is an ovate capsule, three-beaked, unilocular, and cut round: the seed is one, globular, compressed, and large. Of this there are 29 species; the most remarkable of which are: the A. bicolor, melancholicus, or two-coloured amaranthus; A. maximus, or tree-like amaranthus; A. oleraceus, used by the Indians as a substitute for cabbage; A. tricolor or three-coloured amaranthus, which is cultivated in our gardens. The amaranthus are all annuals.

AMARILLIS, a genus of the hexandria monogynia class and order, of the natural order of lilia, which in its flower it resembles. The essential character is, corolla hexapetaloid, irregular; filaments inserted into the throat of the tube, bending down, unequal in proportion or direction. There are 29 species, all of them highly ornamental, but only one, the A. lutea, perfectly hardy in this country. The A. regina, the vittata, the jacobea, belladonna, and Guernsey lily, are well known in the stoves and green-houses of the curious in plants. To describe them is impossible, but no flowers are more beautiful.

AMASONIA, in botany, a genus of the didynamia angiospermia class and order: calyx five-cleft: corolla tubular, with a small five-cleft border: berry four-seeded. There are two species.

AMATEUR, in the arts, denotes a person understanding, loving, or practising the fine arts, without any regard to pecuniary advantage.

AMBASSADOR, a person appointed by one sovereign power to another, to superintend his affairs at some foreign court, and supposed to represent the power from which he is sent. The person of an ambassador is inviolable.

AMBER, is a hard, brittle, tasteless substance; sometimes transparent, but mostly semi-transparent or opaque, and of a glossy surface. It is found of nearly all colours, but chiefly yellow or orange, and often contains leaves, and sometimes insects. Amber, is capable of a fine polish, and becomes electric by friction. When rubbed or heated it emits a peculiar, but agreeable smell. Its specific gravity is from 1.065 to 1.100.

In the second volume of the Edinburgh Philosophical Journal, Dr. Brewster has given an account of some optical properties of amber, from which he considers it established beyond a doubt that amber is an *indurated vegetable juice*; and that the traces of a regular structure, indicated by its action upon polarized light, are not the effect of the ordinary laws of crystalization by which *mellite* has been formed, but are produced by the same causes which influence the mechanical condition of gum Arabic, and other gums, which are known to be formed by the successive deposition and induration of vegetable fluids.

AMBERGRIS, is a substance found floating in the sea near the coasts of various tropical countries. Different opinions formerly prevailed as to the origin of this substance; but it is now allowed to be a concretion formed in the stomach of the *physeter macrocephalus*, or spermaceti whale. Its colour is ash-grey, with brownish yellow and white streaks. It has an agreeable smell, which improves by keeping. Its price being in London so high as a guinea per oz., leads to many adulterations. Genuine ambergris is readily known by the richness of its fragrance when a hot needle is thrust into it.

AMBIDEXTER, a person who can use both hands with the same facility, and for the same purposes, that the generality of people do their right hands.

Were it not for education, some think that all mankind would be ambidexters; and, in fact, we frequently find nurses obliged to be at a good deal of pains before they can bring children to forego the use of their left hands. It is to be regretted, that any of the gifts of nature should be thus rendered in a great measure useless, as there are many occasions in life which require the equal use of both hands: such are the operations of bleeding in the left arm, left ancle, &c.

AMBROSIA, in botany, the name of a distinct genus of plants, with flosculous flowers, composed of several small infundibuliform floscules, divided into five segments: these, however, are barren; the fruit, which in some measure resembles a club, growing on other parts of the plant.

This genus belongs to the monoecia pentandria class and order. There are five species.

AMBROSINIA, in botany, a genus of the monoecia monadelphia class and order; of which there is a species, found in the island of Sicily: spathe one-leafed, separated by a membranaceous partition, containing the stamina in the hinder cell and upper part of the partition, pistils in the outer cell.

AMBRY, a place in which are deposited all utensils necessary for house-keeping.

In the ancient abbeys and priories, there was an office under this denomination, wherein were laid up all charities for the poor.

AMBULIA, a genus of the didynamia angiospermia class and order. It grows in Malabar, has an aromatic smell, and is administered in cases of fever in the form of a decoction.

AMBUSCADE, or **AMBUSH**, in the military art, properly denotes a place where soldiers may lie concealed, till they find an opportunity to surprise the enemy.

AMELLUS, in botany, a genus of the syngenesia superflua: receptacle chaffy: down simple: calyx imbricate: florets of the ray undivided. There are three species.

AMEND, or **AMENDE**, in the French customs, a pecuniary punishment imposed by a judge for any crime, false prosecution, or groundless appeal.

AMENDE *honorable* an infamous kind of punishment inflicted in France upon traitors, parricides, or sacrilegious persons, in the following manner. the offender being delivered into the hands of the hangman, his shirt is stripped off and a rope put about his neck, and a taper in his hand; then he is led into court, where he must beg pardon of God, the king, the court, and his country.

AMERCEMENT, or **AMERCIAMENT**, in

law, pecuniary punishment imposed upon offenders at the mercy of the court.

Amercements differ from fines, the latter being certain punishments growing expressly from some statute, whereas the former are imposed in proportion to the fault.

AMERIMNUM, a genus of the diadelphia decandria class and order, of the natural order of the papilionaceæ or leguminosæ. The essential character is: calyx two-lipped; legume compressed, leafy, two-valved, gaping; seeds few and solitary. There are two species: the one a shrub; and the other, A. ebenus, a tree which rises to 14 feet high, with a very thick stem. It is common in the West Indies, where the wood is cut and sent to England under the name of ebony.

AMETHYST. The amethyst is a gem of a violet colour, and great brilliancy, said to be as hard as the ruby or sapphire, from which it only differs in colour. This is called the oriental amethyst, and is very rare. When it inclines to the purple or rosy colour, it is more esteemed than when it is nearer to the blue. These amethysts have the same figure, hardness, specific gravity, and other qualities, as the best sapphires or rubies, and come from the same places, particularly from Persia, Arabia, Armenia, and the West Indies. The occidental amethysts are merely coloured crystals or quartz.

AMYTHYSTEA, in botany, a genus of the diandria monogynia class and order, and of the natural order anticillatæ and labiatæ. This plant is a native of Siberia; it is an annual, and grows to about a foot in height. The flowers are of a fine blue colour, as are also the upper part of the branches, and the leaves immediately under the umbel, so that they make a fine appearance.

AMIABLE, or **AMICABLE NUMBERS**, are such as are mutually equal to the sum of one another's aliquot parts. Thus the numbers 220 and 284 are amicable numbers. The aliquot parts of 220 are 1, 2, 4, 5, 10, 11, 20, 22, 44, 55, 110, and these added together are equal to 284; and the aliquot parts of 284, are 1, 2, 4, 71, 142, which added together are equal to 220.

AMIANTHUS. See ASBESTOS.

AMICUS *curiæ* in law, if a judge be doubtful or mistaken, in a matter of law, a bystander may inform the court on that matter, as *amicus curiæ*, or the friend of the court.

AMMANNIA, in botany, the name of a genus of plants, belonging to the tetrandria monogynia class and order; the flower is composed of four oval patent petals, growing within the cup; and its fruit is a roundish capsule covered by the cup, and containing four cells. There are seven species, all of which seem to be annual, and being natives of hot climates most of them require protection in this country.

AMMI, *bishop's weed,* in botany, a genus of umbelliferous plants, belonging to the pentandria digynia class and order of Linnæus; the flower is rosaceous and composed of heart-like petals; and its fruit is a small roundish and striated capsule, containing two striated seeds, convex on one side. There are three species all annual.

AMMONIA, in chemistry, volatile alkali when in its purest state exists only in the form of gas, and till the recent, and well-known experiments of Sir H. Davy, was supposed to consist of azote and hydrogen. Pure ammonia may be obtained by putting into a retort three parts of quick lime, with one part of salammoniac in powder, and applying the heat of a lamp to the retort; the gas which comes over is ammonia, and must be received in jars filled with mercury. It forms a liquid on being cooled. This substance is often called hartshorn, because it is obtained from distilling the horn of the hart; sometimes it is called spirit of urine, because it may be obtained from urine by the same process; and spirit of salammoniac, since it may be obtained from that salt. Ammonia in the state of gas is transparent and colourless like air; its taste is acrid and caustic like that of the fixed alkalis, but not near so strong, nor does it like them corrode those animal bodies to which it is applied: its smell is remarkably pungent, though not unpleasant, when sufficiently diluted. Its use as a stimulant to prevent fainting is well known. Animals cannot breathe it without death. When this gas is made to pass through red-hot charcoal, part of the charcoal combines with it, and forms a substance known by the name of prussic acid. Ammonia does not combine with the metals, but it changes some of them into oxides, and then dissolves them.

AMMONIA, in chemistry, a resinous substance brought from the East Indies. It is supposed to be a species of the ferula. It is brought to us in drops or granules, and sometimes in large masses composed of a number of these granules connected together. The best kind is of a yellowish colour without, and white within, of an astringent taste, and castor smell.

AMMUNITION, a general term for all warlike provisions, but more especially powder, ball, &c.

Ammunition, arms, utensils of war, gunpowder, imported without licence from his majesty, are, by the laws of England, forfeited, and triple the value.

AMNESTY, in matters of policy, an act by which two parties at variance, promise to pardon and bury in oblivion all that is past.

Amnesty is either general and unlimited, or particular and restrained, though most commonly universal, without condition or exceptions; such as that which passed in Germany at the peace of Osnaburg in the year 1648.

AMOMUM, in botany, a genus of the monandria monogynia class and order. Gmelin enumerates 20 species of this plant. The first, and indeed the principal of these is the A. zinziber, narrow leaved ginger, cultivated by Miller, and flowering in September. It is a native of the East Indies, and other countries of Asia, and is much used there and in the West Indies. The species are all of a very tender nature, and cannot be raised in this country without the aid of the stove.

AMORPHA, in botany, *bastard indigo*, a genus of plants, belonging to the diadelphia decandria class of Linnæus; the flower of which consists of one petal vertically ovated, hollow, and erect; and the fruit is a lunulated pod, of a compressed form, and covered with

tubercles, in which are contained two seeds, of an oblong kidney-like shape. There are two species.

This shrub grows naturally in Carolina, where formerly the inhabitants made a coarse sort of indigo, which occasioned its name of the bastard indigo.

AMPELIS, in ornithology, the chatterer, a genus of birds belonging to the order of passeres; the tongue is furnished with a rim or margin all round, and the bill is conical and straight. There are seven species, all natives of foreign countries, except the garrulus, which is a native both of Europe and the West Indies.

They appear annually in Scotland in February, and feed on the berries of the mountain ash; they are seldom seen farther south than Northumberland. They are gregarious; feed on grapes, where vineyards are cultivated; are easily tamed, and are esteemed delicious food. This species is about the size of the blackbird; the bill is short, thick, and black; on the head is a sharp-pointed crest reclining backwards; the lower part of the tail is black, the end of a rich yellow; the quill feathers are black, the three first tipped with white, the six next have half an inch of their exterior margin edged with fine yellow, the interior with white.

AMPELITES, *Cannel coal.* a solid, dry opaque fossil, very hard, not fusible, but easily inflammable, and burning with a fine white flame. It is found in Lancashire, and different parts of Scotland, where it is called *Parrot Coal.* It is susceptible of a fine polish, and is made into trinkets, and often passes for jet.

AMPHIBIA, the third class of animals in the system of Linnæus, and so called because the *major part* of the animals which it includes can live with equal facility both on land and in water.

This class of animals, from the structure of their organs, and the power they possess of suspending respiration at pleasure, can support a change of element uninjured, and endure a very long abstinence. The lungs differ widely in appearance, from those of other animals. Some of them are possessed of a high degree of productive power, and are soon furnished with new feet, tails, &c. when by accident, those parts have been cut off. They are in general very tenacious of life, and will continue to move, and exert many of the animal functions, even when deprived of the head itself. By far the greater part of them are *oviparous.*

Dr. Parsons classes amphibious animals under two divisions: 1. Such as live chiefly on land, but go occasionally into the water. 2. Such as chiefly inhabit the water, but occasionally go on shore. To the first division belong the phocæ or seal tribe, frogs, lizards, crocodiles, the hippopotamus, &c.: and to the second belong eels, water serpents, or snakes of every kind.

There are some kinds of insects, and also of birds to which the term amphibious is applied.

AMPHISBÆNA, in zoology, a genus of serpent so called, because it moves with either end forward. The body of the amphisbæna has a number of circular annuli, surrounding it from the head to the extremity of the tail; so that it seems composed of a number of narrow and somewhat rounded rings applied close to one another, and having deep furrows between them. There are only two species, the white and the black.

AMPHISCII, among geographers, a name applied to the people who inhabit the torrid zone.

Amphiscii, as the word imports, have their shadows one part of the year towards the north, and at the other towards the south, according to the sun's place in the ecliptic. They are also called Ascii.

AMPHITHEATRE, in antiquity, a spacious edifice built either round or oval, with a number of rising seats, upon which the people used to sit and behold the combats of gladiators, of wild beasts, and other sports.

AMPHITRITE, a genus of worms, of the order mollusca: body projecting from a tube, and annulate: peduncles or feet small, numerous; feelers two, approximate, feathered; no eyes. There are seven species: of which the A. reniformis, with a rounded body and simple feelers, is three inches long, and inhabits the seas about Iceland. The body is of a most beautiful red: head defended by two semicircular arches: plumes fourteen, and alternately red and white: annulations of the body from 80 to 90, with each a minute tubercle on each side: tail, pointed, and not jointed: tube, red, tough, coriaceous, simple, and four inches long.

AMPHORA, in antiquity, a liquid measure in use among the Greeks and Romans. The Roman amphora contained forty-eight sextaries, and was equal to about seven gallons one pint, English wine-measure; and the Grecian, or Attic amphora, contained one-third more.

AMPLITUDE, an arch of the horizon intercepted between the east or west point, and the centre of the sun, or a planet at its rising and setting, and so is either north and south, or ortive and occasive.

AMPLITUDE *Magnetical,* the different rising or setting of the sun, from the east or west points of the compass. It is found by observing the sun, at his rising and setting, by an amplitude-compass.

AMPUTATION, in surgery, the cutting off a limb, or other part of the body, with an instrument.

AMULET, a charm, or preservative against mischief, witchcraft, or diseases. Amulets were made of stone, metal, simples, animals, and, in a word, of every thing which fancy or caprice suggested; and sometimes they consisted of words, characters, and sentences, ranged in a particular order, and engraved upon wood, &c. and worn about the neck, or some other part of the body.

AMYGDALUS, in botany, a genus of the polyandria monogynia class and order; its characters are, that the calyx is a perianthium, one-leafed, tubulous, inferior, quinquefid, deciduous, divisions spreading and obtuse; the corolla of five petals, oblong-ovate, obtuse, concave, inserted into the calyx; the stamina have filaments about 30, filiform, erect, shorter by half than the corolla, inserted into the calyx; anthers simple; the pistillum has a roundish, villose germ, simple style, of the length of the stamens, and headed stigma; the pericarpium is a roundish, villose, large drupe, with a longitudinal furrow; the seed is a nut, ovate, compressed, acute, with prominent

sutures on each side, reticulated with furrows, and dotted with small holes. The nut of the almond is covered with a dry skin; that of the peach with a small pulp. There are seven species with numerous varieties.

The amygdalus, or almond-tree, is cultivated both for the advantage of the fruit, and as being highly ornamental in shrubberies, plantations, and other descriptions of pleasure ground, from its coming into bloom early in the spring. It is, however, less important in the former than the latter point of view, as the fruit is often liable to miscarry in this climate.

AMYRIS, in botany, a genus of the octandria monogynia class and order, and of the natural order terebintaceæ. Of this plant there are nine species, the principal of which are, 1. A. *balsamifera*, or rose-wood. 2. A. *elemifera*, which is a native of South America. 3. A. Gileadensis, a native of Arabia Felix, from which the balm of Gilead is produced. A. Toxifera, or poison wood, a native of the Bahamas.

AMZEL, in ornithology, the name of a bird of the merula or blackbird kind, of which there are two species; the ring-amzel or merula torquata, and the merula montana, called simply the amzel. The ring-amzel is a little larger than the common blackbird. Its back is of a dusky blackish brown, and its throat and breast are beautifully variegated with spots and streaks of white; and the lower part of the throat is adorned with a fine broad white ring, whence the bird has its name.

ANABASIS, in botany, a genus of the pentandria digynia class and order: essen. char.; calyx, three-leaved: cor. five petalled; berry one-seeded, surrounded by a calyx: there are four species.

ANACARDIUM, or CASHEW-NUT TREE: a genus of the monogynia order, belonging to the decandria class of plants; and in the natural method ranking under the 12th order, holoraceæ.

There is but one species of this tree known, viz. Anacardium occidentale. It grows naturally in the West Indies, and arrives at the height of 20 feet in those places of which it is a native The fruit of this tree is as large as an orange; and is full of an acid juice, which is frequently made use of in making punch. To the apex of this fruit grows a nut, of the size and shape of a hare's kidney, but it is much larger at the end which is next to the fruit than at the other. The shell is very hard; and the kernel, which is sweet and pleasant is covered with a thin film. Between this and the shell is lodged a thick, blackish, inflammable liquor, of such a caustic nature in the fresh nuts, that if the lips chance to touch it, blisters will immediately follow. The kernels are eaten raw, roasted, or pickled. The caustic liquor just mentioned is esteemed an excellent cosmetic with the West India young ladies, but they must certainly suffer a great deal of pain in its application. The milky juice of this tree will stain linen of a good black, which cannot be washed out.

ANACHRONISM, in matters of literature, an error with respect to chronology, whereby an event is placed earlier than it really happened

ANACREONTIC *verse*, in ancient poetry, a kind of verse, so called from its being much used by the poet Anacreon. It consists of three feet and a half, usually spondees and iambuses, and sometimes anapests; such is that of Horace,

Lydia dic per omnes.

ANACYCLUS, a genus of the syngenesia polygamia class and order. The essential character is, recept. chaffy: down emarginate: seeds solitary with membranous wings. There are four species, all annuals, and somewhat resembling the chrysanthemum in the flower, foliage, and habits.

ANAGALLIS, in botany, a genus of plants, belonging to the pentandria monogynia class of Linnæus; the flower of which is monopetalous, multifid, and orbicular; the fruit is a globose capsule, containing only one cell, and dividing horizontally into two hemispheres, the seeds are numerous and angular. There are six species.

ANAGRAM, a transposition of the letters of some name, whereby a new word is formed, either to the advantage or disadvantage of the person or thing to which the name belongs: thus, from Galenus is formed Angelus: from James, Simea; and so of others. A miserable species of false wit.

ANALEMMA, in geometry, a projection of the sphere on the plane of the meridian, orthographically made by straight lines and ellipses, the eye being supposed at an infinite distance, and in the east or west points of the horizon.

ANALOGY, in literature, a certain relation and agreement between two or more things, which in other respects are entirely different: thus the foot of a mountain bears an analogy to the foot of an animal, although they are two very different things.

There is likewise an analogy between beings that have some conformity or resemblance to one another: for example, between animals and plants, and between metals and vegetables; but the analogy is still stronger between two different species of certain animals.

ANALOGY, in grammar, denotes the correspondence which a word or phrase bears to the genius and received forms of a language.

ANALYSIS, among logicians, is a method of tracing things back to their origin, and of resolving knowledge into its original principles. The term is used in a general sense to signify the resolution of any thing compounded, into its constituent parts.

Chemical analysis consists of a great variety of operations, performed for the purpose of separating the component parts of bodies. In these operations the most extensive knowledge of such properties of bodies as are already discovered must be applied, in order to produce simplicity of effect, and certainty in the results. Chemical analysis can hardly be executed with success, by one who is not in possession of a considerable number of simple substances in a state of great purity, many of which, from their effects, are called reagents. The word analysis is applied by chemists to denote that series of operations, by which the component parts of bodies are determined, whether they be merely separated, or exhibited apart from each other; or whether these distinctive properties be exhibited by causing them to enter into new combinations, without the perceptible intervention of a separate state The forming of new com-

binations is called synthesis; and, in the chemical examination of bodies, analysis or separation can scarcely ever be effected, without synthesis taking place at the same time.

ANAMORPHOSIS, in perspective and painting, a monstrous projection, or representation of an image on a plain or curve surface, which, beheld at a proper distance, shall appear regular and in proportion.

ANARRHICAS, in natural history, the *wolf-fish*, a genus of fishes of the order apodes, of which there are three species. The wolf-fish frequents the deep part of the sea, and in the spring approaches the coast, in order to deposit its spawn among marine plants. The A. lupus, or ravenous wolf-fish is found in the northern seas; it grows to the length of 14 or 15 feet. The flesh is said to be good, but it is seldom eaten.

ANAS, in ornithology, a genus of birds of the order anseres. The bill is strong, broad, flat, or depressed, and is generally furnished at the extremity with an additional piece called a nail, the edges of the mandibles are marked with sharp teeth; the nostrils small, oval; tongue broad, edges near the base fringed; toes four, three before and one behind; the middle one the longest. According to Gmelin there are about 120 species.

These birds from the swan down to the teal, are all a clean plumaged, and beautiful race of birds. Those which have been reclaimed from a state of nature, and domesticated are highly useful to man; under his protection they breed in great abundance, and without requiring any great portion of his time or care lead their young to the pool, almost as soon as they are hatched, where they instantly begin to search for their food, which at first consists of weeds, worms, and insects. When farther advanced in life they pick up grain, &c. about farm yards which but for them would be lost. They also pick up the grain which is shaken from the over ripe ears in the fields. On this clean and simple food they soon become fat, and their flesh is accounted delicious and nourishing.

ANASTATICA, in botany, the name of a genus of tetradynamious plants of the order siliculosa, called in English, the rose of Jericho: its flower consists of four roundish petals, disposed in the form of a cross; and its fruit is a short bilocular pod, containing in each cell a single roundish seed. Two species annual.

ANATOMY, is the art of examining animal bodies by dissection. It teaches the structure and functions of these bodies, and shews on what life and health depend. The word is derived from the Greek verb *ανατεμνω*, I cut up; yet, we do not, in the common application of the term, confine it to the mere cutting up of dead bodies, but comprehend in it every operation tending to discover the structure and use of any part of the body. There are few subjects which carry with them so strong a degree of interest as the history of anatomy; but, as a bare outline of it would occupy more room than we can afford for the whole of this article, we shall not enter upon it, but would refer the reader to the numerous and well known works on the subject, which enter at large on every point of real importance connected with the study of this useful art. It may, however, be proper to remark here, that the latest improvements in anatomy are not of such a nature, as essentially to interfere with the definitions and views of anatomists during the last century. Great service has, indeed, been rendered to anatomy during that period, by the intense application of men of the highest scientific eminence; and the amazing perfection with which the different parts of the human body have been delineated in the plates of such men as Soemmering, Baillie, and others, will render their names immortal.

As the human body is composed of solids and fluids, anatomy is usually divided into

1. The anatomy of the solids, and
2. The anatomy of the fluids.

The *solids* of the human body consist of,

1. Bones, which give support to the other parts of the body. 2. Cartilages which are softer than the bones, flexible, and elastic. 3. Ligaments, which are more flexible still, and connect the ends of the bones to each other. 4. Membranes, or planes of minutely interwoven fibres. 5. Cellular substance, which is formed of membranes minutely interwoven with each other. 6. Muscles, which are soft and contractile bundles of fibres. 7. Tendons, which generally form the hard and inelastic terminations of muscles. 8. Viscera, portions of the body loosely contained in great cavities. 9. Glands, which separate various fluids from the blood. 10. Vessels, which are membranous canals dividing into branches and transmitting blood and other fluids. 11. Adipose substance, an animal oil contained in the cells of the cellular membrane. 12. The cerebral substance, which is of a peculiar nature. 13. Nerves which are bundles of white cords connected by one end to the brain or spinal marrow, and thence expanded over every part of the body.

The *fluids* of the human body are,

1. Blood, which circulates through the vessels and nourishes the whole fabric. 2. Perspirable matter, excreted by the vessels of the skin. 3. Sebaceous matter, secreted by the glands of the skin. 4. Urine, by the kidneys. 5. Ceruminous matter, secreted by the ceruminous glands of the ear. 6. Tears, by the lachrymal glands. 7. Saliva, by the salival glands of the mouth, &c. 8. Mucus, by the mucous glands of the mouth, &c. 9. Pancreatic juice, by the pancreas. 10. Bile, by the liver. 11. Gastric juice, by the stomach. 12. Oil, by the vessels of the adipose membrane. 13. Synovia, by the synovial glands of the joints. 14. Seminal fluid, by the testes. 15. Milk, by the mammary glands.

Anatomy, from the names of the parts which it considers, is divided into,

1. Osteogeny, which is the doctrine of the growth of the bones. 2. Osteology, or the doctrine of adult bones. 3. Chondrology, or the doctrine of cartilages. 4. Syndesmology, or the doctrine of ligaments. 5. Myology, or the doctrine of muscles. 6. Bursalogy, or the doctrine of the bursæ muscosæ. 7. Splanchnology, or the doctrine of the viscera. 8. Angiology, or the doctrine of the vessels. 9. Adenology, or the doctrine of the glands. 10. Neurology, or the doctrine of the nerves, &c.

OSTEOGENY.

Osteogeny treats of ossification, or the growth of bones.

It commences in the flat bones of the head

in the form of a radii, which diverge from a common centre.—In the middle of the cylindri-

by a number of minute points.

OSTEOLOGY.

It has been said, that bones consist of fibres and lamellæ. This doctrine is nevertheless false, for the celebrated Scarpa of Pavia has demonstrated that a cellular reticular, and vascular parenchyma constitutes the basis of the earthy matters to which bones owe their solidity, and that consequently their intimate structure is the same with that of the soft parts of the body.

The long cylindrical or triangular bones consist of two epiphyses, which form their teration, and are internally spongy, and of a diaphysis between the two epiphyses, of a compact structure, internally reticular, where its net-work supports the bags of the marrow. The broad or flat bones of the body are extremely irregular in their form.

The periosteum of bones is that membrane which covers them, and conducts to them vessels and nerves.

The marrow of bones is an oleaginous fluid contained within the membranous bags, but its use is totally unknown.

Numerous blood vessels pass into bones by small holes on their surface; and the manner in which these are distributed is beautifully demonstrated by observing the red tinge they assume in animals with whose food madder is mixed.

The bones of the skull are eight in number; the os frontis, the two ossa parietalia, the os occipitis, the two ossa temporum, the os sphenoides, and the os ethmoides. The two last of these are said to be common to the head and face, because they constitute a part of both. We shall consider them in the order in which they are here enumerated.

The os frontis is placed in the fore part of the skull, and forms the brow and the upper part of the orbits of the eyes. It is convex externally, and concave internally, and has a serrated semicircular edge, which is turned upward, while its lower part is extremely irregular.

The ossa parietalia form all the superior, and some of the lateral parts of the skull. They are convex externally, concave internally, and of an irregular quadrangular form. Their sides are anterior, posterior, superior, and inferior, which last is of a semicircular form.

The os occipitis is situated in the lower and back part of the skull. It is convex externally, concave internally, and irregularly rhomboidal in its form.

The ossa temporum are situated at the lower part of the sides and base of the cranium, and are of a very irregular figure. Their upper part, named os squamosum, is externally smooth, and has a thin semicircular edge; their posterior part, called pars mammillaris, is thicker and less regular; and their inferior part becoming smaller, and extending horizontally, obtains the name of os petrosum, from its hardness.

The os sphenoides is situated in the middle of the base of the skull, and extends across it from one temple to the other. It is extremely irregular in its figure.

The os ethmoides is placed in the middle of the fore part of the basis of the cranium.

nares; two ossa turbinata, which are external to, the last; the cells of the bone, which are placed still more externally; and the ossa plana, which are most external, and assist in the formation of the inner sides of the orbits.

These bones of the cranium are connected by certain sutures or serrated junctions: which are, the coronal, ascending over the fore-part of the skull; the lambdoidal, placed at its posterior part; the sagittal, joining these two in the middle of the upper part of the skull; the squamous, which are placed on each side; and the sphenoidal and ethmoidal, surrounding the bones of the same name.

The bones of the face are in all fourteen; and of these the ossa nasi form the arch of the nose: the ossa lachrymalia are seated at the fore part of the inner edge of the orbits of the eyes: the ossa mallarum constitute the prominences of the cheeks; the ossa maxillaria superiora, form the upper jaw, and contain the sixteen upper teeth: the ossa palati, are situated at the posterior part of the palate, nares and orbit: the ossa turbinata inferiora resemble those of the ethmoides: the vomer is a thin bone which completes the division of the nares: the maxilla inferiora is the bone of the lower jaw, containing the inferior sixteen teeth.

The teeth are formed of a bony substance and covered with an enamel. Each tooth consists of a head, a neck, and one or more fangs, or roots, sunk in the jaw. There are three classes, viz. four incisores, or the front teeth of each jaw; two cuspidati, on each side the former; four bicuspides behind the last; and six molares behind these. The last of the molares is termed dens sapientiæ.

The os hyoides, or bone of the tongue, resembles in form the Greek υ, whence its name. It consists of a body, two cornua, and two appendices.

The bones of the trunk consist of those of the spine, the pelvis, and the thorax.

The spine consists of twenty-four true or moveable, and five false or immoveable vertebræ, likewise denominated the os sacrum, and of one small bone named os coccygis. The true vertebræ consist of a body, a ring behind the body transmitting the spinal marrow, and of seven processes, four of which are articular, or serve to connect the vertebræ with each other; and three are for muscular attachment: of these two are termed transverse, from their projecting laterally; and one spinous, from its forming the ridge or spine of the back. The true vertebræ are also divided into classes. The first class is the cervical, including the first seven; the first of which is termed atlas, the second dentatus. The second class is the dorsal, consisting of twelve, which are larger than the cervical, and are distinguished by having their sides and transverse processes depressed for connection with the ribs. The third class is the lumbar, consisting of five, which are larger than any of the superior ones. The os sacrum resembles a reversed pyramid, somewhat concave internally and convex externally. It constitutes the posterior part of the pelvis. The os coccygis, in form, very

much resembles the os sacrum, of which it is merely an appendix fixed to its lower part.

The pelvis, or inferior cavity of the trunk, in addition to the two bones last mentioned, consists of the two ossa innominata.

The thorax, or superior cavity of the trunk, is formed by a long narrow bone, named sternum, and by the twenty-four ribs, which are long, narrow, and curved bones, attached by their heads and posterior ends to the vertebræ. The upper seven, from their being attached in the former way, are named true ribs; the inferior five are termed false.

The shoulder consists of two bones, viz. the clavicula and the scapula. The clavicula or collar bone is situated between the top of the sternum or breast-bone and the extremity of the shoulder, and sometimes resembles in form an Italic *f*. The scapula is a triangular flat bone, which forms the greatest part of th shoulder. It is situated behind the upper part of the thorax.

The arm has only one bone, termed the os humeri, the upper part of which is received by the scapula, and its lower part terminates in two condyles.

The fore arm consists of two bones, viz. the radius and ulna, the latter of which allows of flexion and extension, while at the same time it serves as an axis to the radius, which so revolves around it as to effect the motions of the hand.

The bones of the hand are divided into the carpus, metacarpus, fingers and thumb. The carpus consists of eight small bones, named schaphoides, lunare, cuneiforme, and piziforme, which form the first row; and trapezium, which form the second. The metacarpus consists of four bones, having bases attached to the carpus, and round heads for articulation with the fingers. Each of the fingers, as well as the thumb, consists of three bones; all of which, except the terminating ones, possess a head and base for articulation with their fellows.

The bones of the lower extremities consist of those of the thigh, leg, and foot.

The thigh has only one, termed os femoris, the upper part of which forms a round head, received by a cup-like cavity, called acetabu- [illegible] of the os innominatum. Below thi [illegible] neck of the bone, and at its base two protuberances called trochanters.

The bones of the leg are three, viz. the patella or knee-pan; the tibia, which has a triangular body, and terminates inferiorly in the malleolus internus, or inner ankle; and the fibula a long triangular bone on the outside of the leg, articulated above to the tibia, and below terminating in the malleolus externus, or outer ankle.

The bones of the foot are those of the tarsus, metatarsus, and toes. The tarsus consists of seven bones. The metatarsus is composed of five, having broad bases and round heads. The phalanges of the toes are three in number: each of their bones are shorter than those of the finger, and the great toe possesses only two.

CHONDROLOGY.

Under this head it is only necessary to state that, in the recent subject, the articular surfaces of bones are covered by cartilage. Interarticular cartilages are also placed in some of them, as in the joint of the lower jaw, of the clavicle and sternum, of the knee, &c

SYNDESMOLOGY.

Capsular ligaments surround all the joints; but those which possess the hinge-like motion have also lateral ligaments to render them firm, while those possessing motion in every direction have ligaments internal to the capsular.

BURSALOGY.

The mucous bags, called bursæ mucosæ, are placed wherever tendons pass over each other or over any solid part, and serve the purpose of lubricating these tendons.

MYOLOGY.

Of the muscles of the teguments of the cranium.

1. The occipito-frontalis arises from the transverse ridge of the os occipitis; and is inserted into the orbicularis palpebrarum of each side. Its use is to pull the skin of the head backwards. 2. The corrugator supercilii arises from the internal angular process of the os frontis, and is inserted into the inner and inferior fleshy part of the occipito-frontalis muscle. Its use is to draw the eyebrow of that side towards the other.

Of the muscles of the ear.

The common muscles are,

1. The attolens aurem, arises from the tendon of the occipito-frontalis, and is inserted into the upper part of the ear. 2. The anterior auris arises near the posterior part of the zygoma, and is inserted into a small eminence on the back of the helix. 3. The retrahentes auris arise from the root of the mastoid process, and are inserted into that part of the back of the ear which is opposite to the septum conchæ.

The proper muscles are,

1. The helicis major arises from the acute process of the helix, and is inserted a little above. 2. The helicis minor arises from the inferior and anterior part of the helix, and is inserted into the crus of the helix near its fissure. 3. The tragicus arises from the root of the concha, and is inserted into the point of the tragus. 4. The antitragicus arises from the root of the helix, and is inserted into the tip of the antitragus. 5. The transversus auris arises from the prominent part of the concha on the dorsum of the ear, and is inserted into the contiguous part of the antihelix.

The muscles of the internal ear are three

1. The laxator tympani arises from the spinous process of the sphenoid bone, and is inserted into the long process of the malleus. 2. The tensor tympani arises from the extremity of the eustachian tube, and is inserted into the posterior part of the handle of the malleus. 3. The stapedius arises from the posterior part of the tympanum, and is inserted into the posterior part of the head of the stay

Of the muscles of the eye-lids.

The palpebræ, or eye-lids, have one muscle common to both, and the upper eye-lid one proper to itself.

1. The orbicularis palpebrarum which rises from the outer edge of the orbit, and is inserted into the nasal process of the superior maxillary bone. 2. The levator palpebræ superioris rises from the upper part of the foramen opticum,

and is inserted into the tarsus of the upper eye-lid.

Muscles of the eye-ball.

The muscles which move the globe of the eye are six, viz. four straight and two oblique.

The four straight muscles arise from the bottom of the orbit around the foramen opticum of the sphenoid bone; they are inserted at the fore part of the globe of the eye into the anterior part of the tunica sclerotica: their names are, the levator oculi, depressor oculi, adductor oculi, and abductor oculi.

The oblique muscles are two:

1. The obliquus superior, or trochlearis, arises from the edge of the foramen opticum at the bottom of the orbit, and is inserted into the tunica sclerotica, between the attollens and optic nerve. 2. The obliquus inferior arises from the outer edge of the orbitar process of the superior maxillary bone, and is inserted into the sclerotica, between the abductor and optic nerve.

Of the muscle of the nose.

There is only one muscle on each side that can be called proper to the nose, though it is affected by several muscles of the face.

The compressor naris arises from the root of the ala nasi externally, and is inserted into the anterior extremity of the os nasi.

Muscles of the mouth and lips.

The mouth has nine pair of muscles, inserted into the lips, and a common one formed by the termination of these, viz. three above, three below, three outwards, and the common muscle surrounding the mouth.

The three above are,

1. The levator anguli oris which rises from the superior maxillary bone, and is inserted into the angle of the mouth. 2. The levator labii superioris alæque nasi arises by two origins; the first from the external part of the orbitar process of the superior maxillary bone; the second from the nasal process of the superior maxillary bone. The first and shortest portion is inserted into the upper lip and orbicularis labiorum; the second and longest into the upper lip and outer part of the ala nasi. 3. The depressor labii superioris alæque nasi arises anteriorly from the os maxillare superior and is inserted into the upper lip and root of the ala nasi.

The three below are,

1. The depressor anguli oris, rises from the lower edge of the maxilla inferior, and is inserted into the edge of the under lip. 3. The levator labii inferioris rises anteriorly from the lower jaw, and is inserted into the under lip and skin of the chin.

The three outward are,

1. The buccinator, which rises from the lower jaw; and is inserted into the angle of the mouth. 2. The zygomaticus major arises from the os malæ, and is inserted into the angle of the mouth. 3. The zygomaticus minor rises above the origin of the former, and is inserted near the corner of the mouth.

The common muscle is,

The orbicularis oris. This muscle is, in a great measure, formed by the muscles that move the lips, and surrounds the mouth like a sphincter.

Muscles of the lower jaw.

The lower jaw has four pair of muscles, viz. two which are seen on the side of the face, and two concealed by the angle of the jaw.

1. The temporalis arises from the parietal bone, and the temporal fossa of the cranium, and is inserted into the coronoid process of the lower jaw. 2. The masseter arises from the inferior and interior part of the zygoma, and is inserted into the outside of the angle of the lower jaw. 3. The pterygoideus internus arises from the pterygoid fossa, and is inserted into the angle of the lower jaw internally. 4. The pterygoideus externus arises chiefly from the outer side of the external pterygoid process, and is inserted into the fore part of the condyloid process.

The muscles which appear about the anterior part of the neck.

On the side of the neck are two muscles or layers:

1. The musculus cutaneus vulgo platysma myoides arises from the cellular substance that covers the upper part of the deltoid and pectoral muscles, and is inserted into the integuments covering the side of the lower jaw. 2. The sterno-cleido mastoideus arises by two distinct origins; the anterior from the top of the sternum; the posterior from the upper and anterior part of the clavicle; both unite to be inserted into the mastoid process.

Muscles situated between the lower jaw and os hyoides.

There are four layers before, and two muscles at the side. The four layers are,

1. The digastricus arises from the fossa at the root of the mastoid process of the temporal bone, and is inserted into a roughness at the inferior edge of the chin. 2. The mylo-hyoideus arises from the inside of the lower jaw, and is inserted into the basis of the os hyoides. 3. The genio-hyoideus arises from the middle of the lower jaw internally, and is inserted into the basis of the os hyoides. 4. The genio-hyo-glossus arises from the inside of the middle of the lower jaw, and is inserted into all the length of the tongue, and base of the os hyoides.

The two muscles at the side are,

1. The hyo-glossus arises from the base, cornu, and appendix of the os hyoides, and is inserted into the side of the tongue. 2. The lingualis arises from the root of the tongue laterally, and is inserted into the tip of the tongue.

Muscles situated between the os hyoides and trunk.

1. The sterno-hyoideus arises from about the extremity of the first rib, and is inserted into the base of the os hyoides. 2. The omohyoideus arises from the superior costa of the scapula, near the semilunar nitch, and is inserted into the base of the os hyoides.

The second layer consists of three muscles:

1. The sterno-thyroideus arises from the uppermost bone of the sternum, and is inserted into the inferior edge of the thyroid cartilage. 2. Thyreo-hyoideus arises opposite to the former, and is inserted into part of the basis, and almost all the cornu of the os hyoides. 3. The crico-thyroideus arises from the side and fore part of the cricoid cartilage, and is inserted

into the lower part of the thyroid cartilage; and inferior cornu.

Muscles situated between the lower jaw and os hyoides laterally.

They are five in number.

1. The stylo-glossus rises chiefly from the styloid process, and is inserted into the root, side and tip of the tongue. 2. The stylo-hyoideus rises from the inferior part of the styloid process, and is inserted into the os hyoides between its base and cornu. 3. The stylo-pharyngeus rises from the root of the styloid process, and is inserted into the side of the pharynx and back of the thyroid cartilage.

The two from the pterygoid process are,

1. The circumflexus, or tensor palati, rises chiefly from the spinous process of the sphenoid bone, and spreads into a broad membrane, which is inserted into the velum pendulum palati. 2. The levator palati rises from the pars petrosa of the temporal bone, and is inserted into the velum pendulum palati.

Muscles situated about the entry to the fauces.

There are two on each side, and a single one in the middle.

The two on each side are,

1. The constrictor isthmi faucium rises from the side of the tongue: it is inserted into the middle of the velum pendulum palati. 2. The palato-pharyngeus rises chiefly from the middle of the velum pendulum palati; it is inserted into the edge of the upper and back part of the thyroid cartilage.

The one in the middle is,

The azygos uvulæ, which rises from the extremity of the suture, which joins the palate bones, and is inserted into the tip of the uvula.

Muscles situated on the posterior part of the pharynx.

1. The constrictor pharyngis inferior rises from the side of the thyroid, and from the cricoid cartilage, and is inserted into the middle of the pharynx 2. The constrictor pharyngis medius rises from the appendix and cornu of the os hyoides, and is inserted into the middle of the cuneiform process of the os occipitis. 3. The constrictor pharyngis superior rises from the cuneiform process of the os occipitis, from the pterygoid process of the sphenoid bone and from the upper and under jaw. It is inserted into a white line in the middle of the pharynx.

Muscles situated about the glottis.

1. The cryco-arytænoideus posticus, rises in the back part of the cricoid cartilage, and is inserted into the posterior part of the base of the arytenoid cartilage. 2. The crico-arytænoideus lateralis, rises from the cricoid cartilage laterally, and is inserted into the side of the base of the arytenoid cartilage. 3. The thyreo-arytænoideus rises from the under and back part of the middle of the thyroid cartilage, and is inserted into the arytenoid cartilage. 4. The arytænoideus obliquus rises from the base of one arytenoid cartilage, and is inserted near the tip of the other.

The single muscle is,

The arytænoideus transversus rises from the side of one arytenoid cartilage, and is inserted into the other.

Muscles situated in the fore part of the abdomen.

These consist of three broad layers on each side; always a long one, and generally also a short one, on each side the linea alba.

The three layers are,

1. The obliquus descendens externus, rises by eight heads from an equal number of inferior ribs, and is inserted into the whole length of the linea alba. 2. The obliquus ascendens internus rises from all the spine of the ilium, the os sacrum, the three undermost lumbar vertebræ, and from Poupart's ligament. It is inserted into the cartilago ensiformis, and into the cartilages of the seventh and those of all the false ribs. 3. The transversalis rises from the inner part of the cartilages of the seven lower ribs, from the spine of the os ilium internally, and from the tendon of the external oblique muscle. It is inserted into the cartilago ensiformis, and into the whole length of the linea alba.

The long muscle in the middle is,

The rectus abdominis, which rises from the symphysis pubis, and is inserted into the cartilages of the three inferior true ribs.

The short muscle in the middle is the pyramidalis rising with the rectus, and inserted into the linea alba, half-way between the os pubis and umbilicus.

Muscles about the male organs of generation.

Each of the testes has one muscle.

The cremaster rises from the lower part of the internal oblique, and is inserted into the tunica vaginalis of the testis.

The penis has three pair of muscles.

1. The erector penis rises from the tuberosity of the ischium, and is inserted into the membrane covering the corpora cavernosa penis. 2. The accelerator urinæ, or ejaculator seminis, rises from the sphincter ani and membranous part of the urethra, and from the crus penis. It is inserted into a line in the middle of the bulb. 3. Transversus perinei rises from the membrane covering the tuberosity of the ischium, and is chiefly inserted into the accelerator urinæ.

There is often a fourth muscle, named,

4. Transversus perinei alter, which rises behind the former, runs more forward, and is inserted into the fore part of the accelerator urinæ.

Muscles of the anus.

The anus has a single muscle, and one pair. The single muscle is,

The sphincter ani, which rises from the verge of the anus, and is inserted, before, into the perineum, acceleratores urinæ, and transversi perinei; behind, into the extremity of the os coccygis.

The levator ani rises within the pelvis, and is inserted into the sphincter ani, &c.

Muscles of the female organs of generation.

The clitoris has one pair.

The erector clitoridis, rises internally from the crus of the ischium; and is inserted into the clitoris.

The vagina has one pair.

The sphincter vaginæ, rises from the sphincter ani, and is inserted into the crus and body of the clitoris

The transversus perinei, sphincter ani, and levator ani, in the female almost precisely resemble the same muscles in the male.

Muscles within the pelvis.

Of these there are two pairs.

1. Obturator internus, rises from the internal circumference of the thyroid foramen, and is inserted into the top of the trochanter major. 2. The coccygeus, rises from the spinous process of the os ischium, and is inserted into the end of the sacrum, and into the os coccygis.

Muscles situated within the cavity of the abdomen.

They consist of a single muscle and four pairs.

The diaphragm is a broad thin muscle forming a septum between the thorax and abdomen. It is commonly divided into two portions.

1. The superior or greater muscle rises from the cartilago ensiformis, the cartilages of the seventh and all the inferior ribs, and is inserted into a tendon situated in the middle of the septum. 2. The inferior or lesser muscle of the diaphragm rises from the second, third, and fourth lumbar vertebræ, by eight heads; and is inserted into the posterior part of the middle tendon

The four pairs are,

1. The quadratus lumborum which rises from the posterior part of the spine of the ilium, and is inserted into the transverse processes of the lumbar vertebræ, into the last rib, and the last dorsal vertebra. 2. Psoas parvus, rises from the sides of the two upper lumbar vertebræ, and is inserted into the brim of the pelvis. 3. Psoas magnus, rises from the side of the body and transverse process of the last dorsal vertebra, and from all the lumbar. It is inserted into the trochanter minor. 4. The iliacus internus rises from the transverse process of the last vertebra of the loins, from the crista, and from the hollow part of the ilium. It is inserted along with the former.

Muscles on the fore part of the thorax.

These consist of two layers, and the first layer of one muscle.

The pectoralis major rises from the extremities of the fifth and sixth ribs, from the sternum, and from half the anterior part of the clavicle It is inserted into the groove of the biceps.

The second layer consists of three muscles.

1. The subclavius rises from the cartilage of the first rib, and is inserted into the inferior part of the clavicle. 2. The pectoralis minor, rises from the upper edge of the third, fourth, and fifth ribs, and is inserted into the coracoid process of the scapula. 3. The serratus magnus. rises from the nine superior ribs, and is inserted into the whole base of the scapula.

Muscles placed between the ribs.

These are the intercostales externi et interni, which, rising in two layers from the lower edge of one rib, are inserted into the upper edge of another.

The muscles within the thorax are one pair.

The triangularis, or sterno-costalis, rises from the cartilago ensiformis, and the inferior part of the edge of the middle bone of the sternum. It is inserted into the lower edge of the cartilages of the third, fourth, and fifth ribs.

Muscles on the fore part of the neck, close to the vertebræ.

They consist of one layer, formed by four muscles.

1. Longus colli, rises from the three superior laterally, and from the transverse process of the third, fourth, fifth, and sixth cervical. It is inserted into the fore part of the vertebræ of the neck. 2. The rectus capitis internus major, rises from the transverse processes of the third, fourth, fifth, and sixth cervical vertebræ, and is inserted into the cuneiform process of the os occipitis. 3. Rectus capitis internus major, rises from the body of the atlas, and is inserted into the condyloid process of the os occipitis. 4. The rectus capitis lateralis, rises from the tip of the transverse process of the atlas, and is inserted into the os occipitis external to the foramen magnum.

On the side of the neck,

1. Scalenus anticus rises from the fourth, fifth, and sixth transverse processes of the neck, and is inserted into the upper side of the first rib. 2. Scalenus medius rises from the transverse processes of the cervical vertebræ, and is inserted into the first rib. 3. Scalenus posticus rises from the fifth and sixth transverse processes of the cervical vertebræ, and is inserted into the upper edge of the second rib.

Muscles situated on the back of the trunk.

The following muscles are described as they appear on dissection.

1. The trapezius, rises from the os occipitis, and also from the spinous processes of the two inferior cervical, and from those of all the dorsal vertebræ. It is inserted into the posterior half of the clavicle, the acromion, and the spine of the scapula. 2. The latissimus dorsi rises from the back of the spine of the ilium, the spinous processes of the sacrum and lumbar vertebræ, and from the seven inferior ones of the vertebræ of the back: also from the extremeties of the inferior ribs. It is inserted into the edge of the groove of the tendon of the biceps. 3. The serratus posticus inferior rises from the spinal processes of the two inferior dorsal vertebræ, and from the three superior lumbar. It is inserted into the lower edges of the four inferior ribs. 4. The rhomboideus is divided into two portions. 1. The rhomboideus major, which rises from the spinous processes of the five superior vertebræ of the back, and is inserted into all the basis of the scapula below the spine. 2. Rhomboideus minor, which rises from the spinous processes of the three inferior vertebræ of the neck, and the ligamentum nuchæ. It is inserted into the base of the scapula, opposite to its spine. 5. The serratus superior posticus, rises from the spinous processes of the three last vertebræ of the neck, and the two upper of the back. It is inserted into the second, third, fourth, and fifth ribs. 6. The levator scapulæ rises from the transverse processes of the superior vertebræ of the neck. It is inserted into the superior angle of the scapula.

On the neck,

1. The splenius, rises from the four superior spinous processes of the vertebræ of the back, the five inferior of the neck, and adheres to the

ligamentum nuchæ. It is inserted into the five superior transverse processes of the cervical vertebræ, the back of the mastoid process, and the os occipitis. 2. The complexus rises from the transverse processes of the seven superior vertebræ of the back, and four inferior of the neck. It is inserted into the os occipitis. 3. The trachelo-mastoideus, rises from the transverse processes of the three uppermost dosal and five lowermost cervical vertebræ. It is inserted into the back of the mastoid process. 4. The transversalis colli, rises from the transverse processes of the five uppermost vertebræ of the back. It is inserted into the transverse processes of the cervical vertebræ, except the first and the last. 5. The rectus capitis posticus major, rises from the spinous process of the dentata. It is inserted into the os occipitis. 6. The rectus capitis posticus minor rises from the back part of the atlas. It is inserted behind the foramen magnum. 7. The obliquus capitis superior, rises from the transverse process of the atlas. It is inserted into the os occipitis, behind the back of the mastoid process. 8. The obliquus capitis inferior, rises from the spinous process of the dentata, and is inserted into the transverse process of the atlas.

On the back near the spine:

1. The sacro-lumbalis rises with the longissimus dorsi, and is inserted into the curve of all the ribs. 2. The longissimus dorsi, rises from the side, and all the spines of the sacrum; the posterior spine of the ilium, from the spines, and from the transverse processes of the lumbar vertebræ. It is inserted into the transverse processes of the dorsal vertebræ, and the lower edge of all the ribs except the two inferior. 3. The spinalis dorsi, rises from the spines of the two uppermost lumbar vertebræ, and the three inferior dorsal vertebræ. It is inserted into the spines of the nine upper dorsal vertebræ except the first. 4. The semispinalis dorsi rises from the transverse processes of the seventh, eighth, ninth, and tenth dorsal vertebræ, and is inserted into the spines of all the dorsal vertebræ above the eighth, and the two lower cervical vertebræ.

On the neck:

1. The semispinalis colli rises from the transverse processes of the six uppermost vertebræ of the back. It is inserted into the spines of all the cervical vertebræ, except the first and last. 2. The multifidus spinæ, rises from the side and spine of the sacrum, and the posterior part of the ilium; from all the oblique and transverse processes of the lumbar vertebræ; all the transverse processes of the dorsal vertebræ; and from those of the cervical, except the three first. It is inserted into all the spines of the lumbar, dorsal, and cervical vertebræ, except the first. 1. The interspinales colli rise from the spine of the inferior vertebræ of the neck, and ascend to be inserted into the superior vertebræ. 2. The intertransversales colli, rise from the inferior transverse process of each vertebra of the neck, and first of the back, and are inserted into the superior transverse processes. 3, 4, and 5. The interspinales dorsi et lumborum, and the intertransversales dorsi, are rather small tendons than muscles. 6. The intertransversales lumborum, are four small bundles which fill up the spaces between the transverse processes of the lumbar vertebræ.

Muscles on the shoulder.

1. Deltoides, rises from the clavicle, processus, acromion, and spine of the scapula. It is inserted into the anterior and middle part of the os humeri. 2. Supraspinatus, rises from the basis, spine, and upper costa of the scapula. It is inserted into a large tuberosity at the head of the os humeri. 3. Infranspinatus, rises from the basis and spine of the scapula. It is inserted into the upper and middle part of the tuberosity. 4. Teres minor, rises from the interior costa of the scapula. It is inserted into the lower part of the tuberosity. 5. Teres major, rises from the inferior angle, and costa of the scapula. It is inserted into the ridge at the inner side of the groove formed for the long head of the biceps. 6. Subscapularis, rises from the basis, superior and inferior costæ of the scapula. It is inserted into the upper part of a small tuberosity at the head of the os humeri. 7. Coraco-brachialis, rises from the coracoid process of the scapula. It is inserted into the inner side of the os humeri.

Muscles on the arm.

1. Biceps flexor cubiti, rises from the coracoid process, and the glenoid cavity of the scapula. It is inserted into the tuberosity at the upper end of the radius. 2. Brachialis internus, rises from the os humeri, below, the tendon of the deltoides. It is inserted into the coronoid process of the ulna, and olecranon. 3. Triceps extensor cubiti, rises from the inferior costa of the scapula; from the upper and outer part of the os humeri; and the back part of that bone.

Muscles on the fore arm.

1. Supinator longus, rises from the ridge of the os humeri, a little above its outer condyle. It is inserted into the radius near its styloid process. 2. Extensor carpi radialis longus, rises below the origin of the supinator longus. It is inserted into the upper part of the metacarpal bone of the middle finger. 3. Extensor carpi radialis brevis rises from the outer condyle and the upper part of the radius. It is inserted into the back of all the bones of the four fingers. 4. Extensor digitorum communis, rises from the outer condyle of the os humeri It is inserted into the back of all the bones of the four fingers. 5. Extensor minimi digiti, rises from the outer condyle of the os humeri. It is inserted into the bones of the little finger. 6. Extensor carpi ulnaris rises from the condyle of the os humeri. It is inserted into the metacarpal bone of the little finger. 7. Anconaeus, rises from the outer condyle of the os humeri. It is inserted into the outer edge of the ulna. 8. Flexor carpi ulnaris, rises from the inner condyle of the os humeri, and anterior edge of the olecranon. It is inserted into the os pyriforme. 9. Palmaris longus, rises from the inner condyle of the os humeri. It is inserted into the internal annular ligament. 10. Flexor carpi radialis, rises from the inner condyle of the os humeri. It is inserted into the metacarpal bone of the fore finger. 11. Pronator radii brevis, rises from the outer condyle of the os humeri, and coronoid process of the ulna. It is inserted into the radius, near its middle. 12. Flexor sublimis perforatus, rises from the inner condyle of the os humeri, inner edge of the coronoid process of the ulna, and upper part of the radius. It is inserted into

the second bone of each finger. 13. Supinator radii brevis, rises from the outer condyle of the os humeri, and the ulna. It is inserted into the radius. 14. Abductor pollicis longus, rises from the ulna, interosseous ligament, and radius. It is inserted into the os trapezium, and first bone of the thumb. 15. Extensor minor pollicis, rises from the ulna, and interosseous ligament and radius. It is inserted into the second bone of the thumb. 16. Extensor major pollicis, rises from the ulna and interosseous ligament. It is inserted into the third and last bone of the thumb. 17. Indicator rises from the middle of the ulna. It is inserted into the metacarpal bone of the fore finger. 18. Flexor profundus perforans rises from the upper and fore part of the ulna, and interosseous ligament. It is inserted into the fore part of the last bone of each of the fingers. 19. Flexor longus pollicis; rises from the upper and fore part of the radius. It is inserted into the last joint of the thumb. 20. Pronator radii quadratus, rises from the ulna. It is inserted into the radius, opposite to its origin.

Muscles of the hand.

1. Lumbricales, rise from the tendons of the perforans. They are inserted into the tendons of the extensor digitorum communis. 2. Abductor brevis pollicis, rises from the internal annular ligament, os scaphoides, and one of the tendons of the abductor longus pollicis. It is inserted into the outer side of the second bone of the thumb. 3. Opponens pollicis, rises from the inner and anterior part of the internal annular ligament, and the os scaphoides. It is inserted into the first bone of the thumb. 4. Flexor brevis pollicis, rises from the os trapezoides, internal annular ligament, os magnum, and os unciforme. It is inserted into the ossa sesamoidea and second bone of the thumb. 5. Abductor pollicis, rises from the metacarpal bone of the middle finger. It is inserted into the basis of the second bone of the thumb. 6. Abductor indicis, rises from the inner side of the first bone of the thumb, and from the os trapezium. It is inserted into the first bone of the fore finger posteriorly. 7. Palmaris brevis, rises from the internal annular ligament, and aponeurosis palmaris. It is inserted into the os pisiforme, and the skin covering the abductor minimi digiti. 8. Abductor minimi digiti rises from the internal annular ligament and os pisiforme. It is inserted into the side of the first bone of the little finger. 9. Flexor parvus minimi digiti, rises from the os unciforme, and internal annular ligament. It is inserted into the first bone of the little finger. 10. Abductor metacarpi minimi digiti, rises from the os unciforme, and internal annular ligament. It is inserted into the metacarpal bone of the little finger. 11. Interossei interni, situated between the metacarpal bones. They are inserted into the roots of the fingers. 12. Interossei externi, situated between the metacarpal bones on the back of the hand. They are inserted into the roots of the fingers.

Muscles on the upper part of the thigh.

1. Glutæus maximus, rises from the spine of the ilium, posterior sacro-ischiatic ligaments, os sacrum, and os coccygis. Inserted into the upper part of the linea aspera of the os femoris. 2. Glutæus medius, rises from the spine and superior surface of the ilium. It is inserted into the outer and back part of the great trochanter. 3. Glutæus minimus, from the outer surface of the ilium. It is inserted into the upper and interior part of the great trochanter. 4. Pyriformis, rises from the anterior part of the os sacrum. It is inserted into the root of the trochanter major. 5. Gemini, rises by two portions, one from the outer surface of the spine of the ischium, the other from the tuberosity of the ischium, and posterior sacro-ischiatic ligament. It is inserted into the pyriformis. 6. Obturator internus, rises from the inner border of the foramen thyroideum. It is inserted into the same cavity with the former. 7. Quadratus femoris, rises from the tuberosity of the ischium. It is inserted between the trochanter major and trochanter minor.

Muscles on the thigh.

1. Biceps flexor cruris, rises by two heads: one from the tuberosity of the ischium, the other from the linea aspera, near the insertion of the glutæus maximus. It is inserted into the upper and back part of the fibula. 2. Semitendinosus, rises from the tuberosity of the ischium. It is inserted into the upper and inner part of the tibia. 3. Semi-membranosus, rises from the tuberosity of the ischium. It is inserted into the head of the tibia. 4. Tensor vaginæ femoris, rises from the superior and anterior spinous process of the ilium. It is inserted into the inner side of the fascia lata. 5. Sartolius, rises from the superior and anterior spinous process of the ilium. It is inserted into the upper and inner part of the tibia. 6. Rectus, rises by two tendons; one from the anterior and inferior spinous process of the illium, the other from the posterior edge of the cotyloid cavity It is inserted into the rotula. 7. Gracilis rises from the fore part of the ischium and pubis. It is inserted into the upper and inner part of the tibia. 8. Vastus externus, rises from the anterior and lower part of the great trochanter, and, the outer edge of the linea aspera. It is inserted into the upper and outer part of the rotula. 9. Vastus internus, rises from the inner edge of the linea aspera. It is inserted into the outer and inner part of the rotula. 10. Cruræus, rises from the outer and anterior part of the lesser trochanter. It is inserted into the upper part of the rotula. 11. Pectinalis, rises from the anterior edge of the os pubis. It is inserted into the upper and fore part of the linea aspera. 12. Adductor longus femoris, rises from the upper and fore part of the os pubis. It is inserted near the middle and back part of the linea aspera. 13. Adductor brevis femoris, rises from the fore part of the ramus of the os pubis. It is inserted into the inner and upper part of the linea aspera. 14. Adductor magnus femoris rises from the lower and fore part of the ramus of the os pubis. It is inserted into the whole length of the linea aspera. 15. Obturator externus rises from the obturator ligament. It is inserted into the os femoris.

Muscles on the leg

1. Gastrocnemius externus, rises by two heads; one from the inner condyle, the other

from the outer condyle of the os femoris. It is inserted by a great round tendon, common to this and the following muscle. 2. Gastrocnemius internus rises by two heads; one from the back part of the head of the fibula, the other from the upper and back part of the tibia. It is inserted by a large tendon (the tendo Achillis), common to this and the former muscle, into the lower and back part of the os calcis. 3. Plantaris, rises from the upper and posterior part of the outer condyle of the os femoris. It is inserted into the inside of the back part of the os calcis. 4. Popliteus rises from the outer condyle of the thigh. It is inserted into the upper and inner part of the tibia. 5. Flexor longus digitorum pedis, rises from the upper and inner part of the tibia. It is inserted into the last bone of all the toes, except the great toe. 6. Flexor longus pollicis pedis, rises from the back part, and a little below the head of the fibula. It is inserted into the last bone of the great toe. 7. Tibialis posticus rises from the back part and outer edge of the tibia, and from the interosseous ligament and adjacent part of the fibula. It is inserted into the inner and upper part of the os naviculare, and side of the os cuneiforme medium. 8. Peroneus longus, rises from the outer side of the head of the tibia, and from the upper anterior and outer part of the fibula. It is inserted into the metatarsal bone of the great toe. 9. Peroneus brevis, rises from the outer and forepart of the fibula. It is inserted into the metatarsal bone of the little toe. 10. Extensor longus digitorum pedis, rises from the upper, outer, and fore part of the tibia, interosseous ligament, and inner edge of the fibula. It is inserted into the first joint of the smaller toes. 11. Peroneus tertius, rises from the lower half of the fibula, and the interosseous ligament. It is inserted into the metatarsal bone of the little toe. 12. Tibialis anticus, rises from the upper and fore part of the tibia. It is inserted into the os cuneiforme internum. 13. Extensor proprius pollicis pedis, rises from the upper and fore part of the tibia. It is inserted into the convex surface of the bones of the great toe.

Muscles on the foot.

1. Extensor brevis digitorum pedis, rises from the upper and anterior part of the os calcis. It is inserted by four tendons; one joins the tendon of the externus longus pollicis, and the other three the tendons of the extensor digitorum longus. 2. Flexor brevis digitorum pedis, rises from the lower part of the os calcis. It is inserted into the second phalanx of each of the small toes. 3. Abductor pollicis pedis, rises from the inner and lower part of the os calcis. It is inserted into the first joint of the great toe. 4. Abductor minimi digiti, rises from the outer tubercle of the os calcis, the root of the metatarsal bone of the little toe, and also from the aponeurosis plantaris. It is inserted into the first joint of the little toe. 5. Lumbricalis pedis, rises from the tendons of the flexor longus digitorum pedis. It is inserted into the tendinous expansion, at the parting of the toes. 6 Flexor brevis pollicis pedis, rises from the inferior and anterior part of the os calcis, and the inferior part of the cuneiforme externum. It is inserted into the first joint of the great toe. 7. Adductor pollicis pedis rises from near the roots of the metatarsal bones of the second, third, and fourth toes. It is inserted into the first joint of the great toe. 8. Transversales pedis, rises from the outer and under part of the anterior end of the metatarsal bone of the little toe. It is inserted into the metatarsal bone of the great toe. 9. Flexor brevis minimi digiti pedis, rises from the basis of the metatarsal bone of the little toe. It is inserted into the first joint of the little toe. 10. Interossei pedis interni et externi, situated between the metatarsal bones.

SPLANCHNOLOGY explains the doctrine of the viscera. These are divided into thoracic, abdominal, and pelvic. The cavity of the thorax is divided into five lesser cavities, viz. the anterior cavity of the mediastinum, the posterior cavity of the mediastinum, the cavity of the pericardium, and the right and left cavities of the thorax.

Before describing the abdominal viscera, we may enumerate the salival glands, as they also are referable to the article splanchnology. They are the parotid, maxillary, sublingual, thyroid, molar, buccal, labial, lingual, amygdaline, palatine, uvular, arytenoid, &c. the names of most of which explain their situation.

The abdomen is divided into the epigastric, hypochondriac, umbilical, epicholic, hypogastric, and inguinal regions. Its contents are the peritoneum and its productions, the stomach, the intestines, the liver and gall-bladder, the spleen and pancreas, the kidneys, ureters, &c. The productions of the peritoneum are the great and small omentum and the mesentery, supporting and conveying the vessels to the intestines. The stomach consists of a great and small curvature, a great and small extremity, one orifice named cardiac, and another termed pylorus. The small intestines consist of the duodenum, and the ilium. The great intestines consist of the cæcum, which posesses an appendix, and has upon it the commencement of three ligamentary bands of the colon, externally appendices epiploicæ, and internally valvulæ conniventes forming the cells of the colon, and of the rectum terminating in the anus. The liver consists of two great lobes and a small one; it has a middle, right, left, and a round ligament; its internal structure is composed of the penecilli, or terminations of the venæ portæ, the pori biliarii, in which the bile is secreted, and the hepatic ducts, which terminate in one trunk, and convey the bile from the liver. The gall-bladder consists of a fundus, a body, and a neck, which terminates in the duct called cysticus, and this joining the hepatic, they form together the ductus communis choledocus. The spleen is not properly understood, either in its structure or uses. The pancreas resembles the salivary glands, and possesses a duct which terminates together with the ductus communis choledocus, in the duodenum. The kidneys are placed behind the peritoneum: their internal cavity is called pelvis, and opens into the ureter.

The pelvic viscera consist of the urinary bladder, and the organs of generation. The bladder consists of a bottom, a body, and a neck; its coats are a muscular, a cellular, and a villous. The male organs of generation consist of the testes, which have three coats, the tunica vaginalis, the cremaster, and the tunica

albuginea. The prostate gland is situated between the neck of the bladder and the bulb of the urethra; the projection on its inner surface is named caruncula. The penis itself consists of the corpora cavernosa on each side, the urethra inferiorly, the corpus spongiosum surrounding the former, the glans penis terminating the corpus spongiosum, and the integuments and preputium, which invests the whole. The female organs of generation consist of the pubes, or mons Veneris, the labia, the clitoris consisting of two crura and a body, the nymphæ internal to the labia, the urethra and the vagina, which, in virgins, contains the hymen or circulus membraneus, and its remains called carunculæ myrtiformes. The internal are the uterus and its appendages. The uterus consists of a neck, a body, and a fundus, and has a triangular cavity within it; its inferior aperture is called os tincæ. The ligamenta lata tie the uterus to the sides of the pelvis. The ovaria are fixed by the round ligaments to its corners, and the Fallopian tubes proceed from its fundus towards the sides of the pelvis.

ANGIOLOGY.

ANGIOLOGY, or the doctrine of the vessels of the body, (from αγγειον, a vessel, and λογος, a discourse) is divided into three parts, the first treats of the absorbents, the second of the arteries, and the third of the veins.

Of the absorbent system.

The absorbent system consists of the lacteals, the lymphatic vessels, their common trunk, the thoracic duct, and the glands called conglobate.

The lacteals begin from the intestinal tube, and can, for the most part, be seen in a dog, or other large quadruped, that is killed two or three hours after eating, when they appear filled with a white chyle.

The lymphatic vessels are small pellucid tubes that have now been discovered in most parts of the human body. The fluid they contain is generally as colourless as water; a circumstance which procured them at first the name of ductus aquosi, and afterwards that of vasa lymphatica.

All the lacteals, and most of the lymphatic vessels, open into the thoracic duct, which lies upon upon the spine, and runs up towards the neck, where it commonly opens into the angle between the internal jugular and subclavian veins of the left side: and thus both the chyle and the lymph are mixed with the blood.

The lacteals, the lymphatics, and the thoracic duct, all agree in having their coats thinner and more pelucid than those of the blood-vessels, but they are much stronger.

The coats of lymphatic vessels have, in common with all other parts of the body, arteries and veins for their nourishment.

The lymphatic system in most animals, but particularly in man and quadrupeds, is full of valves; and hence these lymphatics have sometimes been distinguished by the name of valvular lymphatic vessels. Those valves are generally two in number; are of a semilunar shape, and one is sometimes much larger than the other. In some parts of the body there are three or four pair in an inch of space; but sometimes there are several inches of a lymphatic without a valve. They are less numerous in the thoracic duct than in the branches of the system. When the vessels are distended with lymph, they appear larger on that side of the valves next the heart, which gives a lymphatic vessel an appearance of being made of a chain of vesicles.

The lymphatic system has the glands, called conglobate or lymphatic. These glands are so placed, that the vessels come in on one side, and pass out on the other, in their way to the thoracic duct. They are commonly of an oval, though sometimes of a round shape, and of various sizes; some being no larger than a millet seed, while others are almost an inch in diameter. They vary in colour in different parts of the body, and at different times of life.

The absorbent system, besides the glands, is divided into three parts, viz. the lacteal, the lymphatic vessels and the lacteal sac, and the lymphatic duct. The lacteals belong to the intestinal tube, the lymphatics to all the other parts of the body, and the lacteal sac and thoracic duct is the common trunk which receives both the lacteals and lymphatics.

Of the heart, lungs, and arterial system.

By the thorax we commonly understand all that part of the body which answers to the extent of the sternum, ribs, and vertebræ of the back, both outwardly and inwardly.

The thorax is divided into the anterior part, commonly called the breast; the posterior part called the back, and the lateral parts called the right and left sides.

Pleura and mediastinum.

The pleura is a membrane which adheres very closely to the inner surface of the ribs, sternum, and musculi intercostales, sub-costales, and sterno-costales, and to the convex side of the diaphragm. It is of a very firm texture, and is supplied with blood vessels and nerves, in all which it resembles the peritonæum.

Each side of the thorax has its pleura distinct from the other; and situated in such a manner as to form a double septum, or partition, running between the vertebræ and the sternum, their other sides adhering to the ribs and diaphragm.

This particular duplicature of the two pleuræ is termed mediastinum: the two laminæ of which it is made up are closely united together near the sternum and vertebræ; but in the middle, and toward the lower part of the fore side, they are separated by the pericardium and heart. A little more backward they are parted by the œsophagus; and, in the most posterior part, a triangular space is left between the vertebræ and the two pleuræ which is filled chiefly by the aorta.

Before the heart, from the pericardium to the sternum, the two laminæ adhere very closely, and there the mediastinum is transparent, except for a small space near the upper part, where the thymus gland is situated.

The thorax is divided into two cavities, entirely separated from each other by a middle septum, without any communication, and by the obliquity of this partition, the right cavity is greater than the left; but there are exceptions to this description.

The pleura is connected to the membranous

portion of the sternum, ribs, and muscles; to the diaphragm, pericardium, thymus gland, and vessels; and, in a word, to whatever lies near its convex side.

The pleura serves in general for an inner integument to the cavity of the thorax. The mediastinum cuts off all communication between the two cavities, and hinders one lung from pressing on the other when we lie on one side. It likewise forms receptacles for the heart, pericardium, œsophagus, &c.

Pericardium.

The heart, with all the parts belonging to it, is contained in a membranous capsula, called pericardium, which is, in some measure, of a conical figure, and somewhat bigger than the heart; but the difference must be less during life, when the heart is full of blood.

The pericardium is made up of three laminæ; the middle and chief of which is composed of very fine tendinous filaments; they are closely interwoven, and cross each other in different directions. The internal lamina seems to be a continuation of the outer coat of the heart, auricles, and great vessels. The trunks of the aorta and pulmonary artery have one common coat, which contains them both, and is lined on the inside by a cellular substance.

The pericardium is connected to the diaphragm exactly at that place which answers to the flat or lower side of the heart; and it is a very difficult matter to separate it from the diaphragm in dissection.

The external lamina, or common covering, is formed by the duplicature of the mediastinum.

The internal lamina is perforated by an infinite number of very small holes, through which a serous fluid continually transudes. This fluid being generally collected after death, makes what is called aqua pericardii, found in considerable quantities in opening dead bodies while they remain fresh.

Of the heart.

The heart is a muscular body, situated in the cavity of the thorax on the anterior part of the diaphragm between the two laminæ of the mediastinum. It is of a conical figure, flatted on the sides, round at the top, and oval at the basis. Accordingly we consider in the heart, the basis; the apex; two edges, the one right and the other left; and two sides, one of which is generally flat and inferior, the other more convex and superior.

Besides the muscular body, which forms what we chiefly call the heart, its basis is accompanied by two appendices called auriculæ, and by large blood-vessels; and all these are included in the pericardium.

The heart is hollow within, and divided by a septum into two cavities called ventriculæ, one of which is thick and solid, the other thin and soft.

Each ventricle opens by two orifices; one of which answers to the auricles, the other to the mouth of a large artery. The right ventricle opens into the right auricle, and the trunk of the pulmonary artery; the left into the left auricle, and into the great trunk of the aorta. At the edges of these orifices are found several valves, of which some are turned inward toward the cavity of the ventricles called the tricuspid; others are turned toward the great vessels, called semilunar, or sigmoid.

The inner surface of the ventricles is very uneven, many eminences and cavities being observable therein. The most considerable eminences are thick fleshy productions, called columnæ carniæ. To the extremities of these are fastened several chordæ tendidæ, tendinous cords, the other ends of which are joined to the valvulæ tricuspides.

The valves at the orifices of the ventricles are of two kinds; one kind allows the blood to enter the heart, and hinders it from going out the same way; the other kind allows the blood to go out of the heart, but hinders it from returning.

The auricles are two muscular bags, situated at the basis of the heart, and their capacities are in proportion to those of their respective ventricles; one toward the right ventricle, the other toward the left, and joined together by an inner septum, and external communicating fibres, much in the same manner with the ventricles; one of them being named the right auricle, the other the left.

The right auricle is larger than the left, and joins the right ventricle by a common tendinous opening.

It has two other openings united into one, and formed by two large veins which meet and terminate there almost in a direct line, called vena cava, superior and inferior.

Of the lungs.

The lungs are two large spongy bodies, of a reddish colour in children, greyish in adult subjects, and bluish in old age; filling the whole cavity of the thorax, one being seated in the right side, the other in the left, parted by the mediastinum and heart.

The right lung is generally larger than the left, answerable to the cavity of the breast, and to the obliquity of the mediastinum.

The substance of the lungs is almost all spongy, being made of an infinite number of membranous cells, and of different sorts of vessels spread among the cells in innumerable ramifications.

This whole mass is covered by a membrane continued from each pleura, which is commonly said to be double.

The vessels which compose part of the substance of the lungs are of three or four kinds; the principal of these are air vessels and blood-vessels. The air-vessels make the chief part, and are termed bronchia.

These bronchia are conical tubes, connected together by a ligamentary elastic membrane; and disposed in such a manner, that the lower easily insinuate themselves within those above them.

The bronchia are divided into an infinite number of ramifications, which diminish gradually in size, and change their cartilaginous structure into that of a membrane.

Each of these bronchial tubes is widened at the extremity, and formed into a cell called a vesicle. These cells are closely connected together in bundles; each small branch producing a bundle proportionable to its extent, and the number of its ramifications.

The lobules appear to be parted by another cellular substance, which surrounds each of them in proportion to their extent, and fills up the interstices between them.

This substance is dispersed through every part of the lungs, and is afterwards spread over the outer surface of each lung, where it forms a kind of fine cellular coat.

All the bronchial cells are surrounded by a very fine reticular texture of the small extremities of arteries and veins, which communicate every way with each other.

The blood-vessels of the lungs are of two kinds; one common, called the pulmonary artery and veins; the other proper, called the bronchial arteries and veins.

The pulmonary artery goes out from the right ventricle of the heart; and as high as the curvature of the aorta, is divided into two lateral branches, one going to the right hand, the other to the left.

The pulmonary veins go out on each side by two great branches, which open laterally into the reservoir or muscular bag of the right auricle.

The ramifications of the arteries are larger and more numerous than those of the veins, which in all other parts of the body exceed the arteries both in number and size.

Besides the capital blood-vessels, there are others called the bronchial arteries and veins, which are very small, but they follow the bronchia through all their ramifications. They communicate with the pulmonary arteries and veins, likewise with the arteries and veins of the œsophagus, and with branches of the coronary artery and vein.

Under the root of each lung, there is a broad ligament, which ties the posterior edge of each lung to the lateral parts of the vertebræ of the back from the root all the way to the diaphragm.

The bronchia, already described, are branches or ramifications of a large canal, partly cartilaginous, and partly membranous, called trachea, or aspera arteria. It is situated anteriorly in the lower part of the neck, whence it runs down into the thorax between the two pleuræ through the upper space left between the duplicature of the mediastinum, behind the thymus.

Having reached as low as the curvature of the aorta, it divides into lateral parts, one toward the right hand, the other toward the left, which enter the lungs, and are distributed through them.

Of the arteries in general.

The arteries are long elastic and pulsating tubes, the diameters of which decrease according to the number of branches which they give off.

The coats of the arteries are three in number: an external or cellular coat, a middle or muscular coat, and an internal or smooth membranous coat.

The use of the arteries is to convey blood from the heart through the lungs, throughout the system in general, or the heart itself.

The aorta.

The large arteries, termed aorta, open with a wide orifice from the superior and posterior side of the left ventricle of the heart. Its roots seem incorporated with the very substance of the heart: as it is not only intimately united with its internal surface, but some muscular striæ of the ventricle are also mixed with the white line, which is called tendo-arteriosus, and which indicates the commencement of the artery. Some transverse fibres of the heart are united to the external part of the aorta, and cover it for a line and a half. Having left the heart, the aorta is immediately expanded; nor does it again recover its diameter till it sends off the subclavian artery of the right side.

In its ascent, it is first inflected to the right, behind and beyond the pulmonary artery; it gradually inclines itself to the left, till, having formed a transverse arch, it is seen projecting behind the lungs at the left side of the vertebræ. Supported by these it descends in the same straight line with themselves: till, having, at last, entered the abdomen, it again begins to turn toward the right, and rests upon the middle of the vertebræ.

The two coronary arteries of the heart arise from beneath the semilunar valves, and form, in returning to the heart, an acute angle with the rising trunk.

From the arch of the aorta rise also the subclavian and carotid arteries. The right subclavian and carotid in one trunk, but the left is single.

The carotid arteries run along each side of the larynx to the sixth foramen of the skull, where they enter and proceed to the brain. In their passage thither, they give out numerous branches, which are named from the parts to which they go, as laryngæ, thyroidæ, linguales, temporales, &c. These also send out each a small branch through the fifth foramen to that part of the dura mater which contains the cerebrum.

The internal carotids send two branches to the posterior part of the nose, and some others through the first and second foramen of the skull, to the face and the parts within the orbits of the eyes; and after perforating the internal surface of the dura mater, divide each into two distinct branches, one passing between the two hemispheres of the brain, and the other between the anterior and posterior lobes.

These branches assume a variety of directions, and divide into numerous small branches in the pia mater before they reach the brain. There are two other arteries belonging to the brain named cervicales, which have their origin in the subclavian arteries, and rise to the head through the foramina. These send branches to the cerebellum, after which they divide and communicate with the carotids.

Each of the subclavian arteries is continued to the cubit in one trunk, this is called axillaris, as it passes the armpits, and humeralis, as it passes the os humeri. From the subclavian within the breast the arteriæ mammariæ arise, which run along the inside of the sternum. The arteria humeralis, near the joint of the cubit divides into two branches, named the cubitalis superior and inferior; the latter soon sends off another, called cubitalis media. The two first give branches to the hands and fingers, and the last to the muscles about the elbow.

From each side of the descending aorta, a branch is sent under each rib, which is termed intercostalis, and towards the fourth vertebra of the back, it sends two branches to the lungs, which are termed bronchiales. Where this aorta passes under the diaphragm it sends

to it two branches called arteriæ phrenicæ. Below the diaphragm, rises the cæliac artery from the aorta. This divides into several branches, passing to the liver, the pancreas, the stomach, and duodenum, which are named from the parts on which they are bestowed.

Just below the cæliac artery, from the aorta, rises the mesenteric, which is the largest of the ventral branches. The branches of this artery are distributed upon the intestinum, jejunum, and ilium, part of the colon, and sometimes on the liver.

A little below this, the emulgents, or arteries of the kidneys arise; and below these, and anterior to the aorta, arise the spermatic arteries which in the male subject are distributed to the genitals.

Laterally, and a little below the aorta, sends out branches to the loins; these are called lumbales; also one which goes to the colon and rectum, called the inferior mesentery.

Between the cæliac and two mesenteric arteries, and their branches near the intestines, are situated large branches to convey the blood from one to the other when they are compressed.

When the aorta divides on the loins, it sends an artery to the pelvis, on the os sacrum, which arteria sacra; the branches into which the aorta divides, are called iliacæ.

These are the internal and external. From the first proceed the umbilical arteries; the other branches are bestowed on the glutæi muscles, and on the upper part of the thighs.

The iliacæ external run over the ossa pubis into the thighs, and in their passages out of the abdomen, they send out the branches called epigastricæ, to the integuments under the recti muscles. Each of the epigastric arteries sends a branch into the pelvis, and through the foramina of the ossa inominata, to the muscles in that part.

The iliac artery having passed out of the abdomen into the groin is named inguinalis, and in the thigh it is called cruralis. Here it sends a branch to the back part of the thigh, and having passed through the insertion of the triceps into the ham, it takes the name of popliteal artery. It divides into two branches, one called tibialis anticus, which passes between the tibia and fibula down the fore part of the leg, and is bestowed on the great toe, and another between them to communicate with the tibialis postica: this artery sends off the tibialis media which is bestowed on the muscles of the leg.

The tibialis posticus proceeds to the bottom of the foot and lesser toes: the antica is disposed after the manner of the cubitalis superior: and the postica like the cubitalis inferior.

Of the veins.

Veins are membranous canals, which terminate either in the vena cava superior, vena cava inferior, or vena portæ. Like the arteries, they consist of three tunics, but have no pulsation, collapse when divided, possess a greater diameter than the arteries, have more numerous branches, a more reticular arrangement, and run more superficially. Except the veins of the viscera and brain, these vessels also possess valves.

The veins of the external part of the head and neck are the frontal, angular temporal, auricular, lingual, occipital, and muscular. All these terminate in the external jugular, which opens into the subclavian. The veins or sinuses of the brain, viz. the cavernous, circular, petrosal, occipital, longitudinal, superior, and inferior, the torcular, herophili, and the lateral, terminate in the internal jugular. The vertebral veins returning from the brain, terminate in a similar manner.

The chief veins of the other extremities are the axillary in the axilla, the brachial in the arm, and the cephalic on the outside, the median on the middle, and the basilic on the inside of the fore arm. The cephalic and basilic veins being joined by the mediana cephalica and mediana basilica, pass up the arm.

The veins of the thorax are the interna thoracic veins, the vena azygos, and the two subclavian.

The vena portæ, distributed through the liver, derives its blood from the mesenteric and splenic veins.

Those of the loins and pelvis exactly correspond to the lumbar and pelvic arteries.

The veins of the lower extremities are the vena saphena major, which passes up the inside of the leg and thigh, and terminates in the groin; the vena saphena minor, which passes up the outside of the leg, and terminates in the ham; the popliteal and the crural veins, which accompany their corresponding arteries.

It must be observed, that both in the leg and in the thigh, each deep-seated artery is accompanied by two corresponding veins, denominated vena sodales.

Of the eye.

The principal and most essential part in each organ, is the globe or ball of the eye; the others are partly external and partly internal. The external parts are the supercilia, or eye-brows, the palpebræ, or eye-lids, the caruncula lachrymalis, and the puncta lachrymalia; and the internal parts are the muscles, fat, lachrymal gland nerves and blood-vessels

The globe or ball of the eye

The globe of the eye being the most essential of all the soft parts belonging to the organ of sight, must be first described. It is made up of several parts; some of which being more or less solid, represent a kind of shell formed by the union of several membranous strata, called the coats of the globe of the eye; the other parts being more or less fluid, and contained in particular membranous capsulæ, are termed the humours of the globe of the eye. The coats of the globe of the eye are of three kinds. Some form chiefly the shell of the globe; some are additional, being fixed only to a part of the globe; and some are capsular, which contain the humours. The coats, which form the globe of the eye, are, the sclerotic, to which the convexity of the globe is owing; the cornea, which forms the anterior part of the globe; the iris, or circle, surrounding the pupil, choroides, and retina, or expansion of the optic nerve. The additional is the conjunctiva, which covers the whole fore part of the eye, and lines the eye-lids. The capsular tunicæ are two, the vitreæ and cystallina.

The globe of the eye receives from behind a pedicle, which is the continuation of the optic

nerve. It is situated about the middle of the orbit; and it is tied to it by the optic nerve, by six muscles, by the tunica conjunctiva, and by the palpebræ. The back part of the globe, the optic nerve, and muscles are surrounded by a soft, fatty substance, which fills the rest of the bottom of the orbit. The humours are three: the aqueous, vitreous, and crystalline. The first is contained in a space formed in the interstices of the anterior portion of the coats. The second is contained in a particular membranous capsula, and fills above three-fourths of the shell or cavity of the globe of the eye. It has been named vitreous, from its supposed resemblance to melted glass; but is really more like the white of a new-laid egg. The crystalline humour is so called from its resemblance to crystal.

The external parts of the eye.

The supercilia, or eye-brows, are the two ridges covered with hair, situated at the lower part of the forehead, between the top of the nose and temples.

The palpebræ are a kind of veils placed above and below the anterior portion of the globe of the eye. The superior is the largest and most moveable in man.

The tarsi are thin cartilages forming the principal part of the edge of each palpebra; and they are broader at the middle than at the extremities. The ligaments of the tarsi are formed by the union of the periosteum of the orbits, and pericranium along both edges of each orbit. The lacrymal gland, is yellowish, and of the number of those called conglomerate glands. From this gland several small ducts go out, which run down through the substance of the tunica interna, and afterwards pierce it inwardly near the superior edge of the tarsus.

The flat edge of each palpebra is adorned with a row of hairs, called cilia, or the eye-lashes.

Along the same border of the palpebræ, toward the eye, we see a row of small holes, which may be named puncta ciliaria. They are the orifices of small oblong glands which lie in the sulci, channels, on the inner surface of the tarsus. Near the great and internal angle of the palpebræ lacrymales, ductus, two small holes are very visible, commonly named puncta lacrymalia, being the orifices of two small ducts called lacrymal, which unite beyond the angle of the eye, and open a little below the upper end of a particular reservoir, termed sacculus lacrymalis. The caruncula lacrymalis is a small reddish, granulated, oblong body, situated between the internal angle of the palpebræ and globe of the eye.

Of the ear.

Two portions are distinguished in the external ear; one large and solid, called pinna, which is the superior, more cartilaginous, and by much the greater part; the other small and soft, called the lobe, which makes the lower part.

The fore side is divided into eminences and cavities. The eminences are four, called helix antihelix, tragus, and antitragus. The helix is the large border, or circumference of the great portion of the ear. The antihelix is the oblong eminence, surrounded by the helix. The tragus is the small anterior protuberance below the extremity of the helix. The antitragus is the posterior tubercle, below the inferior extremity of the antihelix.

The cavities on the fore side are four; the hollow of the helix, the depression at the extremity of the antihelix, the conchæ, or great double cavity; and lastly, the meatus of the external ear, situated at the lower part of the bottom of the concha.

The bony part of the organ of hearing may be divided into four parts. 1. The meatus auditorius externus. 2. The tympanum. 3. The labyrinth. 4. The meatus auditorius internus. It may likewise be divided into immoveable or containing parts, which take in all the four already mentioned; and moveable or contained parts, which are four little bones lodged in the tympanum, called incus, malleus, stapes, and os obiculare or lenticulare.

The meatus externus is somewhat more than half an inch in length, running in a curved direction. It terminates inwardly by an even circular edge.

The tympanum, or drum of the ear, is a cavity somewhat hemispherical, the bottom of which is turned inward. The remarkable eminences are three; a large tuberosity, lying in the very bottom of the tympanum, a little toward the back part, and a small irregular pyramid situated above the tuberosity, and a little more backward, the apex of which is perforated by a small hole. In the third eminence is a cavity situated at the upper end a little toward the anterior part of the bottom of the tympanum.

The principal cavities in the tympanum are the opening of the mastoid cells, the opening of the Eustachian tube, the bony half-canal, the fenestra ovalis and rotunda; and the small hole in the pyramid.

The labyrinth is divided into three parts; the anterior, middle, and posterior; the middle portion is termed vestibulum, the anterior cochlea, and the posterior labyrinth in particular, which comprehends the three semicircular canals.

The cochlea lies forward and inward, toward the extremity of the pars petrosa; the semicircular canals backward and outward, toward the basis of the process, and the vestibulum between the other two.

The meatus auditorius internus is on the back side of the pars petrosa, in some measure behind the vestibule and basis of the cochlea fossulæ; one large and the other small.

The Eustachian tube, is a canal, which goes from the tympanum to the posterior openings of the nares, and towards the arch of the palate.

The membrana tympani is a thin, transparent, flattish pellicle, the edge of which is round, and strongly fixed in the orbicular groove which divides the bony meatus of the external ear from the tympanum, or barrel. The whole internal cavity of the labyrinth is filled with a watery fluid, secreted from the vessels, which are dispersed upon the periosteum. This fluid transmits to the nerves the vibrations it receives from the membrane situated between the tympanum and labyrinth.

The portio mollis of the auditory nerve ends, by its trunk, at the great fossula of the internal auditory hole, whence the filaments pass through the cochlea, the vestibule, and the semicircular canals, upon membranous canals, and bags disposed within them.

Of the nose and the sense of smelling.

The cavity of the nose is divided into parts called the nostrils, by a partition of which the upper part is bony, and the lower cartilaginous. The upper part of the cavity is covered with a thick glandulous membrane, above which the olfactory nerve is finely branched out, and spread over the membrane of the spongy bones of the nose, and other sinuous cavities of the nostrils. The odorous effluvia of bodies being disseminated in the atmosphere, the latter fluid passes through the nose in respiration, and the odorous particles are thus brought into contact with the fibres of the nerves, which, by their communication with the brain, excite in the mind the sense of smell.

Of the mouth, and organ of taste.

The bony parts of the mouth are the ossa maxillaria, ossa palati, maxilla inferior, and the teeth; to these we may add os hyoides, and the upper vertebræ of the neck.

The external parts of the mouth require no description.

The internal parts of the mouth are, the gums, palate, septum palati, uvula, amygdalæ, the tongue, the membrane which lines the whole cavity, the salival ducts and glands, and the bottom of the mouth.

The palate is that arch of the mouth, surrounded anteriorly by the alveolar edge and teeth of the upper jaw, and reaching thence to the great opening of the pharynx. The arch is partly solid and immoveable, and partly soft and moveable.

The velum palati terminates below by a loose floating edge, representing an arch, situated transversely above the basis, or root, of the tongue. The highest portion of this arch sustains a small, soft, and irregularly conical glandular body, fixed to the arch, and its apex hanging down, without adhering to any thing, which is called uvula. On each side of the uvula there are two muscular half arches, called columnæ septi palati, which contain between them the glands called amygdalæ.

The tongue is divided into the basis and point, the upper and under sides, and the lateral portions or edges. The papillæ with which the tongue is covered are composed of the extremities of the nerves of that member, and piercing the external membrane, are constantly affected by those qualities in bodies which have their tastes excited in the mind by means of these nervous papillæ, which are the immediate organ of tasting. This organ bears a considerable resemblance to the sense of touch.

Of the skin and organ of touch.

The common integuments are divided into cuticula, rete, mucosum, cutis vera, and corpus adiposum.

The skin is covered by a thin transparent pellicle, closely joined to it, called epidermis, cuticula, or scarf-skin.

Under the cuticle, we meet with a substance of a greyish colour, which has the name of corpus cuticulare, or rete mucosum; it is of a soft, mucilaginous, and viscid nature, and fills up the interstices of the fibres running between the cutis vera and cuticula. After raising the cuticle in a negro, where it is thickest and most distinct, this substance appears of a black colour, and is composed of two layers. It is this that chiefly gives the colour to the skin, for it is black in the African, and white, brown, or yellowish, in the European.

The cutis vera, or skin, is made up of several kinds of fibres, closely connected together, and running in various directions, being composed of the extremities of numerous vessels and nerves.

In different parts of the body, we meet with small glands, or follicles, of an oval form, and seated chiefly under the skin in the corpus adiposum. These are called sebaceous and miliary.

The last universal integument of the human body is the membrana adiposa, or corpus adiposum.

The nails are productions of the epidermis.

The hairs belong as much to the integuments as the nails. Their roots, or bulbs, lie toward that side of the skin which is next the membrana adiposa.

The papillæ of the fingers may become erect or elevated, and being gently pressed against a tangible body, receive an impression which is conveyed to the brain, and is called touch.

Of the brain

This mass is divided into three particular portions: the cerebrum, or brain, properly so called, the cerebellum, and medulla oblongata. To these three parts, a fourth is added, which fills the great canal of the spina dorsi, by the name of medulla spinalis, being a continuation of the medulla oblongata.

The meninges, or membranes of the brain, are two; one of which lies contiguous to the cranium; the other immediately touches the brain. The first is named dura mater, the second pia mater.

The Cerebrum.

The cerebrum, is a kind of medullary mass, of a greyish colour, filling all the superior portion of the cavity of the cranium. The cerebrum is divided into two lateral portions, separated by the falx, or great longitudinal septum of the dura mater. They are generally termed hemispheres, but they are more like quarters of an oblong spheroid. Each of these portions is divided into two extremities, which are termed the lobes of the cerebrum, between which there is a large inferior protuberance, which goes by the same name.

Each lateral portion of the cerebrum has three sides; one superior, one inferior, and one lateral. Through the whole surface there are inequalities, or windings, like the circumvolutions of intestines, very deep and narrow, into which the septa, or duplicates of the pia mater, insinuate themselves.

Substance.—The substance of the cerebrum is of two kinds, distinguished by two different colours, one part of it being of a greyish or ash colour, the other, remarkably white. The ash-coloured substance lies chiefly on the outer part of the cerebrum, like a kind of cortex, whence it has been named substantia corticalis, or cinerea. The white substance occupies the inner part, and is termed substantia medullaris or substantia alia.

Between the two hemispheres of the cerebrum, and below the circumvolutions, is found

a white convex body called corpus callosum; and under this are the two lateral or superior ventricles of the brain; these are divided into right and left by a membrane called septum lucidum.

The septum lucidum is united by its lower part, to the anterior portion of the medullary body, called the fornix. It is in reality nothing but the corpus callosum; the lower side of which is like a hollow ceiling, with three angles, one anterior, and two posterior, and three edges, two lateral and one posterior.

Under the fornix, and immediately behind its anterior crura, there is a hole, the foramen Monroi, of a considerable size, by which the two lateral ventricles communicate, and another passage leads down from this, under the different appellations of foramen commune anterius, vulva, iter ad infundibulum, but more properly iter ad tertium ventriculum. Although this is denied by some writers on anatomy, who affirm that it is shut up at the bottom by the pia mater.

The fornix being cut off, we see first of all a vascular web, called plexus choroides, and several eminences more or less covered by the expansion of that plexus. There are four pairs of eminences, two large, and two small. The first two great eminences are named corpora striata, and the second thalami nervorum opticorum. The four small eminences are closely united together; the anterior being called nates, and the posterior testes; but it would be better to call them simply anterior and posterior tubercles. Immediately before these tubercles, there is a single eminence called glandula pinealis, or pineal gland, which Des Cartes supposed to be the seat of the soul.

The plexus choroides is a very fine vascular texture, consisting of a great number of arterial and venal ramifications, partly collected in two loose vasculi, and partly expanded over the neighbouring parts, and covering the thalami nervorum opticorum, glandula pinealis, tubercula quadrigemina, and the other adjacent parts, both of the cerebrum and cerebellum, to all which it adheres.

The Cerebellum.

The cerebellum is contained under the transverse septum of the dura mater, in the under and back part of the cranium.

It is made up like the cerebrum, of two substances. It has two middle eminences, called appendices vermiformes: one anterior and superior, and turned forward; the other posterior and inferior, which goes backward.

When we separate the two lateral portions or lobes, we discover first of all the posterior portion of the medulla oblongata; and in the posterior surface of this portion, we observe an oblong cavity, which is called the fourth ventricle; this terminates backward, like the point of a writing pen. Hence the under end of it is called calamus scriptorius. If we cut one lobe of the cerebellum vertically, from above downward, the medullary substance will appear to be dispersed in ramifications, through the cortical substance. These ramifications have been named abor vitæ, and the two trunks, whence these different laminæ arise, are called pedunculi cerebelli.

Medulla oblongata

The medulla oblongata is a medullary substance, situated from before backward in the middle part of the basis of the cerebrum and cerebellum, without any discontinuation between the lateral parts of both these bases.

Medulla spinalis.

The medulla spinalis is only an elongation of the extremity of the medulla oblongata, and has its name from being contained in the bony canal of the spina dorsi.

It is worthy of observation that the characteristics of the three substances just mentioned appear in this, viz. that wounds in the cerebrum, though, in most cases very dangerous, are not mortal; but in the cerebellum, and medulla oblongata, they cause instant death; and in the spinal marrow, they occasion loss of sense in all the parts which receive nerves from below the wounds.

Of the Nerves.

In several places we can observe the medulla to be composed of fibres laid at each other's sides; and it is employed in forming the white fibrous cords, which have now the name of nerves appropriated to them. Within the skull, we see the nerves to be the medullary substance continued, and the spinal marrow is employed in forming all nerves.

How small one of these fibres of the nerve is, we know not; but when we consider that every, even the most minute part of the body is sensible, and that this must depend upon the nerves, (which, all conjoined, would not make a cord of an inch diameter) being divided into branches or filaments, to be dispersed through all these minute parts, we must be convinced that the nervous fibrils are very small.

Nerves are generally lodged in a cellular or fatty substance, and have their course in the interstices of muscles and other active organs, where they are guarded from pressure; but in several parts they are so placed, as if it was intended that they should there suffer the vibrating force of arteries, or the pressure of the contracting fibres of muscles.

The larger cords of the nerves divide into branches as they go off to the different parts; the branches being smaller than the trunk from which they come. Where the nerves separate, they generally make an acute angle.

In several places different nerves unite into one cord, which is commonly larger than any of the nerves which form it. Several nerves, after such union, suddenly form a hard knot, considerably larger than all the nerves of which it is made. These knots are generally named ganglions.

It is generally said, that there are forty pair of nerves in all · of which ten come out from the encephalon, and the other thirty have their origin from the spinal marrow.

Of the ten pair of nerves which come from the encephalon, the first is the olfactory, which long had the name of the mamillary processes of the brain, because in the brutes, cows and sheep, which were more commonly dissected by the ancients, the anterior ventricles of the brain are extended forward upon these nerves, and adhere so firmly to them, that they seem to make the upper side of the nerves.

The second pair of nerves, the optic, rising from the thalami nervorum opticorum, make a large curve outward, and then run obliquely inward and forward, till they unite at the fore-part of the cella tunica; these soon divide, and each runs forward and outward, to go out at its proper hole in the sphenoid bone, to be extended to the globe of the eye, within which each is expanded into the retina.

The third rise from the anterior part of the processus annularis; and piercing the dura mater a little before, run along the receptacula to get out at the foramina lacera; after which each of them divides into branches, of which one, after forming a little ganglion, is distributed to the globe of the eye; the others are sent to the muscular rectus of the palpebra, and to the attollens, adductor, deprimens, and obliquus minor, muscles of the eye-ball.

The fourth pair, derive their origin from the back part of the base of the testes; and then making a long course on the side of the annular protuberance, enter the dura mater a little further back, and more externally, than the third pair, to run also along the receptacula, to pass out at the foramina lacera, and to be entirely spent on the musculi trochleares, or superior muscles of the eyes.

The fifth pair are large nerves, rising from the annular processes, where the medullary processes of the cerebellum join in the formation of that tube to enter the dura mater; and then each becomes in appearance thicker, forms a distinct ganglion, and goes out of the skull in three great branches.

The first branch runs through the foramen lacerum to the orbit. It is afterward distributed to the ball of the eye with the third; and to the nose, with the olfactory. This ophthalmic branch likewise supplies the parts at the internal canthus of the orbit, the glandula lachrymalis, fat, membranes, muscles, and teguments, of the eye-lids.

The second branch called maxillaris superior, from its serving principally the parts of the upper jaw, goes out at the round hole of the sphenoid bone, and sends immediately one branch into the channel on the top of the antrum maxillare; the membrane of which, and the upper teeth, are supplied by it in its passage.

The sixth pair rise from the fore part of the corpora pyramidalia, and having passed through the dura mater, send off a branch, which, with the ophthalmia branch of the fifth pair, forms the beginning of the intercostal nerve; after which it passes through the foramen lacerum to be spent on the musculus abductor oculi.

The seventh pair rises from the lateral part of the annular process, and enters the internal meatus auditorius, where it divides into two parts, one of which is stretched on the inner camera of the ear, and the other passing through the fallopian aqueduct, comes out on the skull. The former is called portio mollis, the latter dura. This supplies the neck and other parts.

The eighth pair of nerves, named par vagum, from the number of parts to which it gives branches both in the thorax and abdomen, rises from the base of the corpora olivaria, in disgregated fibres, and at the aperture belonging to the ossa temporum and occipitis, this pair of nerves is then joined by the accessores Willisii, with which they pass out at the common foramen already mentioned. After this the accessorius separates, and is lost in the musculus trapezius and rhomboides scapula; whilst the great trunk runs down the neck near the carotid artery, and, on its entering the thorax, divides into two parts, the one supplying the pericardium, after which it is lost in the larynx; the other supplying the lungs, the gula, and stomach.

The ninth pair of nerves rise from the inferior part of the corpora pyramidalia, and go through the os occipitis, and are finally lost on the tongue.

The tenth pair rise in separate threads from the sides of the spinal marrow. After each of them has given branches to the great ganglion; it is distributed to the straight, oblique, and extensor muscles of the head.

The spinal nerves rise generally by a number of disgregated fibres from both the fore and back part of the medulla spinalis; and soon after form a little knot or ganglion, where they acquire strong coats, and are extended into firm cords: but the ganglion is entirely formed by the posterior bundle. There are generally said to be thirty pairs of them; seven of which come out between the vertebræ of the neck, twelve between those of the back, five between those of the loins, and six from the false vertebræ.

EXPLANATION OF THE ANATOMICAL PLATES.

Plate II.

A front view of the Skeleton.

1. The cranium.
2. The os frontis.
3, 3. The orbits.
4. Upper jaw-bone.
5. Teeth.
6. Lower jaw-bone.
7. The seven true ribs.
8. The five false ribs.
9. The first bone of the sternum.
10. The second bone of the sternum.
11. Ensiform cartilage.
12. The five lumbar vertebræ.
13. Ilium, or haunch bone.
14. Os ischii.
15. Os pubis.
16. Os sacrum, or bone of the rump.
17. Symphisis pubis.
18. Thigh-bone.
19. Head of the thigh-bone.
20. Trochanter major.
21. Patella, or knee-pan.
22, 23. External and internal condyles of the thigh.
24. Tibia,
25. Fibula.
26. Bones of the tarsus.
27. Bones of the metatarsus
28. Bones of the toes.
a. The clavicle, or collar-bone.
b. Scapula, or shoulder-blade.
c. Humerus, or bone of the arm.
d. Ulna.
e. Radius.
f. First row, or phalanx of carpal bones.
g. Second row, or phalanx of carpal bones.
h. Bones of the metacarpus.
i. First phalanges of the fingers.

k. Second phalanges of the fingers
l. Third phalanges.
m. Three phalanges of the thumb

PLATE III.

A back view of the Skeleton.

1, 2. Ossa parietalia.
3. Occipitis.
4. Os temporis.
5. Mastoid process of the temporal bone.
6. The seven cervical vertebræ.
7. The twelve dorsal vertebræ.
8. The five lumbar vertebræ.
11. Os sacrum, or rump-bone.
12. Os coccygis, or crupper bone
13. Ilium.
9. Ischium.
14. Neck of the thigh bone.
15. Trochanter major.
16. Trochanter minor.
17. Condyles of the thigh
18. Malleolus externus.
19. Malleolus internus.
20. Os calcis.

ANCHOR, in maritime affairs, is a very large and heavy iron instrument, with a double hook at one end, and a ring at the other, by which it is fastened to a cable. It is cast into the bottom of the sea, or rivers, where, taking its hold, it keeps ships from being drawn away by the wind, tide, or currents. The kinds of anchor in common use are the sheet anchor, the largest, which is only used in storms; the two bowers, made for ships to ride in harbours; the stream anchor; the grapple. To which we may add the newly invented anchor with one fluke by Mr. Stuard; and the new mooring anchor described by Mr. Hemman of Chatham; and for which he obtained the silver medal in 1809 from the Society for the Encouragement of Arts, &c.

ANCHORAGE, or ANCHORING-GROUND, a place where a ship may cast anchor.

The best anchoring-ground is stiff clay or hard sand; and the best place for riding at anchor, is where a ship is land-locked, and out of the tide.

ANCHOVY, in ichthyology and commerce, a species of clupea, with the upper jaw longest. See CLUPEA.

The anchovy is so like the common sprat, another species of clupea, that it is no wonder this fish is often pickled and sold under its name.

ANCHUSA, ALCANET or BUGLOSS; a genus of the monogynia order, belonging to the pentandria class of plants. The calyx is a quinquepartite perianthium, oblong and persistent; the corolla is monopetalous and funnel shaped, the throat closed with scales; the stamina consist of five short filaments; the antheræ oblong and covered; the pistillum has four germina, a filiform stylus, and obtuse stigma: there is no pericarpium, the calyx containing the seeds in its bosom: the seeds are four, oblong, gibbous, and engraven at the base. There are eight species, all of which may be propagated by seeds.

ANCISTRUM, a genus of the *diandria monogynia* class and order, and of the natural order of *rosaceæ*. The essential character is, cal. four-leaved, cor. none; stigma, many parted: drupe, dry, hispid, one-celled.

There are three species, but scarcely deserving notice

ANDALUSITE, or HARDSPAR, in mineralogy, a species of the felspar family, discovered by Bournon, in a primitive granitic mountain in Forez. Colour, flesh red, sometimes approaching to rose red. Massive, and crystallized, in rectangular four-side prisms. Specific gravity 3.16. Infusible by the blowpipe without addition. It is distinguished from felspar by its great hardness, and higher specific gravity, and from corundum, by its inferior specific gravity and its form. It is now found in the primitive mountains in Spain and France, with quartz and mica, and sometimes in a mica state at Braunsdorf, near Freyberg, in Saxony.

ANDRACHNE, in botany, a genus of the monoecia gynandria class of plants; the corolla of the male flower is formed of five emarginated slender petals, shorter than the cup; the female flower has no corolla; the fruit is a capsule containing three cells, with two obtuse trigonal seeds, roundish on one side, and angular on the other. There are three species.

ANDROGYNA, in botany, are plants which bear male and female flowers, with stamens only, and some with pistils only on the same root: such are the cucumber and melon.

ANDROIDES, in mechanics, is a term used to denote an automaton, in the figure of a man, which, by means of certain springs, levers, &c. duly contrived, walks and performs other external functions of a man. The most celebrated of these that have been exhibited in modern times were, the flute-player of Vaucanson, constructed and exhibited at Paris; the chess-player of M. de Kempelin of Presburg; and the chess-player lately exhibited in London The principle on which these ingenious pieces of mechanism produce their effects has hitherto remained a secret.

ANDROMEDA, in astronomy, a small northern constellation consisting of 63 stars, 27 of which are visible to the naked eye.

ANDROMEDA, in botany, a genus of the decandria monogynia class of plants; the calyx of which is a very small acute coloured and permanent perianthium, cut into five segments; the corolla consists of a single petal, of an oval form, inflated and quinquefid; the fruit is a roundish capsule, containing five cells, in which are several roundish shining seeds. There are 25 species.

ANDROPOGON, in botany, a genus of the polygamia monoecia class of plants, the calyx of which is a bivalve oblong, obtuse glume; the corolla is also a bivalve glume, smaller and thinner than the cup; there is no pericarpium; the seed, which is single, oblong, covered and armed with the arista of the flower, is included in the glumes of the calyx and corolla. There are 32 species.

ANEMOMETER, an instrument used for measuring the strength of the wind.

ANEMONE, WIND-FLOWER: a genus of the polygamia order, belonging to the polyandria class of plants; and in the natural method ranking under the twenty-sixth order, multisiliquæ. It has its name from the Greek, *ανεμος*, signifying the wind; because the flower is supposed not to open unless the wind blows.

There are 25 species of the anemone: the

double ones are propagated by offsets; and all the sorts are considered as among the finest ornaments of our gardens.

ANEMOSCOPE, a machine shewing from what point of the compass the wind blows.

This is done by means of an index moving about an upright circular plate, the index being turned by an horizontal axis, and the axis by an upright staff, at the top of which is the vane moved about by the wind.

ANETHUM,* *Dill*, in botany, a genus of umbelliferous plants of the digynia order, and pentandria class. The fruit is oval, compressed, striated: petals five, involute, entire, and short. There are three species, 1. *Anethum feniculum*, or fennel, of which there are two varieties, the common and the sweet; both cultivated in gardens; the common is a perennial plant; but the sweet fennel dies after it has produced seed. 2. *Anethum graveolens*, or *dill*, which is an annual plant. 3. *Finochio*, a sallad herb. The seeds and roots of the first kind are used in medicine.

ANGEL, a term which properly signifies *messenger*, and is used to designate those spiritual beings who are employed as the medium through which the Divine Being carries on the government of the universe.

It is also applied in Scripture to human beings who have been employed in any remarkable manner in executing the Divine will upon earth.

ANGEL, in commerce, the name of an ancient gold coin in England, of which some are still to be seen in the cabinets of the curious. It had its name from the figure of an angel, represented upon it. It was 23¾ carats fine, and weighed four pennyweights. Its value differed in different reigns.

ANGELICA, a genus of the digynia order, belonging to the pentandria class of plants, and in the natural method ranking under the 45th order, umbellatæ. The essential characters are: the fruit is roundish, angled, solid, with reflecting styli; the corollæ are equal, and the petals incurvated. There are six species. The angelica arch-angelica, sativa, or common angelica, which is cultivated in gardens for medicinal use, and likewise for a sweetmeat, grows naturally in the northern countries. The root, which is the most efficacious part, is used in the aromatic tincture; and the stalks make an agreeable sweetmeat.

ANGIOSPERMIA, in the Linnæan system of botany, denotes those plants of the didynamia class, which have their seeds inclosed in a capsule, or seed-vessel.

ANGLE, in geometry, the inclination of two lines meeting one another in a point, and called the legs of the angle. See GEOMETRY.

ANGLING, among sportsmen, the art of fishing with a rod, to which are fitted a line, hook, and bait.

In angling the following rules are to be observed. 1. To place yourself so that your shadow does not at any time lie upon the water, if shallow. 2. To angle in a pond near the ford where the cattle go to drink; and in rivers, in such places as the fish you intend to angle for, usually frequent; as for breams, in the deepest water; for eels, under banks; for chub, in deep shaded holes; for perch, in scours; for roach, in the same places; for trouts, in quick streams.

The best times for angling are from April to October; for in cold stormy weather, or bleak easterly winds, the fish will not bite. The time of the day, in the warm months, is in the morning, about nine o'clock, and in the afternoon, between three and five. In order to attract the fish to the place intended for angling, it will be proper, once in four or five days to cast in some corn boiled soft, garbage, worms chopt to pieces, or grains steeped in blood, and dried; and if you fish in a stream, it will be best to cast in the grains above the hook.

The best way of angling with the fly, is down the river; and in order to make them rise freely, be sure to use such flies as you know they are naturally inclined to, and in such manner as they are accustomed to receive them.

ANGURIA, in botany, a genus of the monoecia diandria class and order: calyx five-cleft: corolla five-petalled: pome inferior, two-celled, many-seeded.

ANGUIS, in zoology, the name of a genus of serpents, distinguished from the rest by having the belly and under part of the tail covered with scales, like those on the other parts of the body. The body is shorter, and more uniformly cylindric, than in the genus of the coluber, and the eyes are in general small, and the tail rather obtuse. No poisonous species of anguis has yet been discovered. Gmelin enumerates 26 species of the anguis.

ANIMAL, in natural history, an organized and living body, which is also endowed with sensation: thus, minerals are said to grow or increase, plants to grow and live, but animals alone to have sensation.

The description, history, and classing of animals, makes not only a considerable, but the most excellent part of natural history, known by the name of zoology. Different authors have established different divisions or families of animals; but the most natural one seems to be into quadrupeds, birds, fishes, amphibious animals, insects, and animalcules, visible only by the help of a microscope.

ANIMALCULE, an animal so minute in its size, as not to be the immediate object of our senses.

Animalcules are seen only by the assistance of microscopes, and are perhaps more numerous than any other part of the animal creation; but the species, on a close examination, are found to be but few, in proportion to the number of individuals. The most obvious distinction among them is, that some have, and others have not tails; and that some have, and others have not visible limbs. They are usually arranged into three classes. 1. Gymnia, or those which are without limbs. 2. Cercaria, or those which have tails. 3. Arthronia, those which have visible limbs.

ANIME, improperly called gum anime, is a resinous substance imported from New Spain and the Brazils. There are two kinds, distinguished by the names of oriental and occidental. The former is dry, and of an uncertain colour, some specimens being greenish, some reddish. and some of the brown colour of myrrh. The latter is in yellowish-white, transparent, somewhat unctuous tears, and partly in larger masses, brittle, of a light pleasant taste, easily melting in the fire, and

burning with an agreeable smell. Like resins, it is totally soluble in alcohol, and also in oil.

ANIME', in heraldry, a term used when the eyes of any rapacious creature are borne of a different tincture from the creature itself.

ANNALS, in matters of literature, a species *of history, which relates events in the* chronological order in which they happened. They differ from perfect history in this, that annals are a bare relation of what passes every year: whereas history relates not only the transactions themselves, but also the causes, motives, and springs of actions. Hence annals require nothing but brevity, history demands ornament.

ANNEAL. We know too litt' of the arrangement of particles to determine what it is that constitutes or produces brittleness in any substance. In a considerable number of instances of bodies which are capable of undergoing ignition, it is found that sudden cooling renders them hard and brittle. This is a real inconvenience in glass, and also in steel, when this metallic substance is required to be soft and flexible. The inconveniences are avoided by cooling them very gradually, and this process is called annealing. Glass vessels, or other articles, are carried into an oven or apartment near the great furnace, called the leer, where they are permitted to cool, in a greater or less time, according to their thickness and bulk. The annealing of steel, or other metallic bodies, consists simply in heating them, and suffering them to cool again, either upon the hearth of the furnace, or in any other situation where the heat is moderate, or at least the temperature is not very cold.

ANNONA, or *Custard Apple*, a genus of the polyandria poligynia class and order. The characters are: the calyx is a triphylous perianthium: the corolla consists of six heart-shaped petals: the stamina have scarcely any filaments; the antheræ are numerous, sitting on the receptaculum: the pistillum has a roundish germen; no styli: the stigmata obtuse and numerous: the pericarpium is a large roundish unilocular berry, covered with a scaly bark: the seeds are numerous. There are 10 species.

ANNOTTO, in commerce, a kind of red dye, brought from the West Indies. It is procured from the pulp of the seed-capsules of a tree called bixa in South America. See **Bixa.**

The annotto is prepared only by the Spaniards; the mode is as follows: the contents of the fruit or capsule are thrown into a wooden bowl, where as much hot water is poured on them as is necessary to suspend the red matter or pulp. When the seeds are left quite naked, they are taken out, and the wash is left to settle. The water is then poured off, and the sediment dried by degrees in the shade, after which it is made into balls or cakes for exportation.

ANNUAL, an appellation given to whatever returns every year: thus we say, the annual motion of the earth, annual plants, &c.

ANNUAL *plants*, called also simply *annuals*, are such as only live their year, *i.e.* come up the spring, and die again in the autumn.

ANNUITIES, periodical payments of money, amounting to a fixed sum in each year, and continuing for a certain period, as for 10, 50, or 100 years; or for an uncertain period, to be determined by a particular event, as on the failure of a life, or for an indefinite term; which latter are called perpetual annuities. The times of payment are either yearly, *half-yearly, quarterly, weekly, or at any other intervals that may be determined on previous to the commencement of the annuity, or regulated during its continuance.*

All calculations relating to annuities are made on the principle of improving money at compound interest, and are generally for an annuity of 1*l.*, from which the value of any other annuity is easily derived. Let r represent the amount of 1*l.* in one year; that is, 1*l.* increased by a year's interest, then r_n, or r, raised to the power whose exponent is any given number of years, will be the amount of 1*l.* in those years; its increase in the same time is r^n-1; now the interest for a single year, or the annuity answering to the increase, is $r-1$; therefore, as $r-1$ is to r^n-1, so is u (any given annuity) to a its amount. Hence we have

$$\frac{u\times\overline{r^n-1}}{r-1}=a,$$

by which the amount of an annuity for any number of years at any given rate of interest is found. In the same manner the present value of annuities is obtained; for, as 1*l.* is the present value of r_n, its amount in n years, and as the present value of any other amount, and consequently of $\frac{u\times\overline{r_n-1}}{r-1}$ must bear the same proportion to that amount, we have

$$\frac{u\times\overline{1-\frac{1}{r^n}}}{r-1 \qquad r-1}=p.$$

From these theorems, the other cases relating to annuities may be easily deduced; but as the involution of high powers is a tedious operation by common arithmetic, most questions relative to annuities may be more conveniently answered by the help of logarithms.

ANNULET, in architecture, a small square member in the Doric capital, under the quarter round. Annulet is also a narrow flat moulding which is common to divers places of the columns, as in the bases, capitals, &c.

ANOMALISTICAL *year*, in astronomy, the time that the earth takes to pass through her orbit: it is also called the periodical year. The space of time belonging to this year is greater than the tropical year, on account of the precession of the equinoxes.

ANOMALOUS *verbs*, in grammar, such as are not conjugated conformably to the paradigm of their conjugation: they are found in all languages; in Latin the verb *lego* is the paradigm of the third conjugation, and runs thus, *lego, legis, legit;* by the same rule it should be *fero, feris, ferit,* but we say *fero, fers, fert; fero* then is an anomalous verb. In English the irregularity relates often to the preter tense, and passive participle; for example, *give,* were it formed according to rule,

would make *gived* in the preter tense, and passive participle; whereas, in the former, it makes *gave*, and in the latter *given.*

ANONIS, *rest-harrow*, in botany, a genus of plants, the flower of which is papilionaceous, and its fruit a turgid villose pod, containing a few kidney-like seeds.

This genus belongs to the diadelphia decandria class of Linnæus, who calls it *ononis.*

ANSER, the trivial name of the common goose. See **Anas.**

Anser, in astronomy, a star of the fifth or sixth magnitude, in the milky-way, between the swan and eagle.

ANT, in entomology, a well-known insect, much celebrated for its industry and economy. See **Formica** and **Termes.**

ANTARCTIC, in a general sense, denotes something opposite to the artic, or northern pole. Hence,

Antarctic *circle*, in geography and astronomy, is one of the lesser circles of the sphere, and distant only 23° 30′ from the south pole, which is likewise called antarctic, for the same reason.

ANTECEDENT, in grammar, the word to which a relative refers: thus, *God whom we adore*, the word God is the antecedent.

Antecedent, in mathematics, is the first of two terms of a ratio, or that which is compared with the other, as in the ratio of 2 to 3, or *a* to *b*, 2 and *a* are each antecedents.

ANTELOPE, in zoology, a genus of quadrupeds. The generic character is, horns hollow, with a bony core, pointing upwards, annulated or wreathed, permanent; front teeth in the lower jaw, eight; no canine teeth. Antelopes have but lately been included in a separate genus: they were formerly placed under that of the goat. They form a link indeed between the goat and deer kind, but possess sufficiently distinctive marks to entitle them to stand apart from them both. They are in general natives of the hottest part of the globe, and peculiarly of Asia and Africa, Europe having but two species, and America none.

Antelopes have a slender elegant make, and are singularly swift in their motions: they are restless, timid, vigilant, and full of animation. Their chace is a favourite amusement in the East; and such is their speed that the fleetest dogs cannot overtake them: on which account falcons are trained to assail them, and by pecking at their eyes, to check their course, and throw them into confusion.

Antelopes have the singular property of sometimes stopping short, and gazing at their pursuers. The beauty of their eyes affords a favourite object of comparison to eastern poets. They usually prefer hilly countries, and associate in numerous herds. They graze on herbage, or crop the shoots of trees, and their flesh is generally of a very delicate flavour. There are 28 species.

ANTENNÆ, in the history of insects, slender filaments with which nature has furnished the heads of these creatures, being the same with what in English are called horns, or feeders.

ANTHEMIS, in botany, *chamomile*, a genus of the syngenesia superflua class and order. Receptacle chaffy; seeds generally crowned with a slight border; calyx hemispherical, nearly equal; florets of the ray more than five, oblong. There are two divisions of this genus, namely A. with a differently coloured or white ray; and B. ray the colour of the disk or yellow: there are about forty species.

ANTHERA, among botanists, that part of the stamen which is fixed on the top of the filamentum, within the corolla; it contains the pollen or fine dust, which, when mature, it emits for the impregnation of the plant.

ANTHERICUM, spider-wort, a genus of the monogynia order, belonging to the hexandria class of plants; and, in the natural method, ranking under the 10th order coronariæ. The essential character is, corolla of six oblong petals, expanding; the pericarpium is an ovate trisculated capsule, with three cells and three valves. There are between 50 and 60 species.

ANTHISTIRIA, in botany, a genus of the trygynia order, belonging to the triandria class of plants, and, in the natural method, ranking under the 4th order, gramina. There is only one species of this grass, the ciliata or fringed anthistiria, a native of India.

ANTHOCEROS, the *horn flower*, a genus of the order of algæ, and of the cryptogamia class of plants. Of this plant there are three species. 1. A. livis, which is a native of Europe. 2. A. multisidus, a native of Germany, 3. A. punctalus, or spotted anthoceros, a native of Britain.

ANTHOLOGY, ανθολογια, a discourse of flowers, or of beautiful passages from any authors. It is also the name given to a collection of epigrams taken from several Greek poets.

ANTHOLYZA, mad flower a genus of the monogynia order, belonging to the triandria class of plants; and in the natural method ranking under the 6th order, ensatæ.

ANTHOSPERMUM, the amber tree, a genus of the diœcia order, belonging to the polygamia class of plants, and in the natural method ranking under the 17th order, stellatæ. The essential characters are; the calyx of the hermaphrodite flower is divided into four parts; there is no corolla; the stamina are four, and the pistilla two; the germen is beneath the flower. Male and female on the same or separate plants. Of this genus Linnæus mentions three species, viz. 1. A. Æthiopica. 2. A. ciliare. 3. A. herbacea.

ANTHOXANTHUM, or **vernal grass**, a genus of the digynia order, belonging to the diandria class of plants; and in the natural method ranking under the 13th order, gramina. The essential characters are: the calyx is a bivalved gluma, with one flower; the corolla is bivalved, obtuse, and without any awn. There are three species, the principal of which, viz. the odoratum is one of the earliest grasses in this country, and imparts the odoriferous smell to new mown hay.

ANTHROPOPHAGIA, signifies the act of eating human flesh.

The origin of this custom, barbarous as it is, some authors trace as high as the deluge. In the southern part of Africa, and in some parts of America, this horrid practice is said still to prevail. Mr. Marsden, in his history of Sumatra, informs us that the battas of that island are anthropophagi. They do not eat human flesh

to satisfy hunger, but as a mode of shewing an abhorrence of their enemies. The objects of this savage repast are prisoners taken in war. When sentence is pronounced, the unhappy victim is tied to a stake; and when mortally wounded by lances thrown at him by the assembled multitude, they rush upon him, cut pieces from his body with their knives, dip them in a dish, previously prepared, of salt and lemon-juice, slightly broil them over a fire, and then devour them with savage enthusiasm.

ANTHYLLIS, *kidney-vetch*, or *lady's finger*, a genus of the decandria order, belonging to the diadelphia class of plants; and in the natural method ranking under the 32d order, papilionaceæ. The essential characters are; the calyx is ventricose, and the legumen is roundish and covered. This genus is separated into the A. herbaceous, and the A. shrubby: there are of the former 12 species, and of the latter nine.

ANTICHORUS, in botany, a genus of the octandria monogynia class and order. Calyx four-leaved; petals four; capsule superior, subulate, four-celled, four-valved; seeds numerous. There is only one species, found in Arabia.

ANTIMONY. The word antimony is always used in commerce to denote a metallic ore, consisting of sulphur combined with the metal which is properly called antimony. Sometimes this sulphuret is termed crude antimony, to distinguish it from the pure metal, or regulus, as it was formerly called. According to Prof. Proust, the sulphuret contains 26 per cent. of sulphur.

Antimony is of a dusky-white colour, very brittle, and of a plated or scaly texture. Its specific gravity, according to Brisson, is 6.7021, but Bergman makes it 6.86. Soon after ignition it melts, and by a continuance of the heat it becomes oxidized, and rises in white fumes, which may afterward be volatilized a second time, or fused into a hyacinthine glass, according to the management of the heat: the first were formerly called argentine flowers of regulus of antimony. In closed vessels the antimony rises totally without decomposition. This metallic substance is not subject to rust by exposure to air, though its surface becomes tarnished by that means. Its oxides are a little soluble in water; and in this respect they resemble the oxide of arsenic, by an approach toward the acid state.

Antimony combines readily with the softer metals, and the alloys thus formed, have been hitherto applied chiefly in the manufacture of music plates and printing types. Medicine is indebted to antimony for some of its most active and valuable remedies. The acid of tartar forms with it the preparation called antimoniated tartrate of potass, formerly known by the name of emetic tartar.

ANTIPATHES, in natural history, a genus of worms of the order zoophyta. The animal grows in the form of a plant; the stem within is horny, with small spines; the base is expanded, the outside covered with a gelatinous flesh, and beset with polype bearing warts. There are thirteen species.

ANTIPODES, in geography, a name given to those inhabitants of the globe that live diametrically opposite to one another. They lie under opposite parallels and opposite meridians. They have the same elevation of their different poles. It is midnight with one when it is noon with the other; the longest day with the one is the shortest with the other; and the length of the day with the one is equal to that of the night of the other.

ANTIQUARY, one who studies the remains of former ages. There is a society of antiquaries in London; it was instituted in the year 1751; and another in Edinburgh instituted in 1780.

ANTIQUITIES, a term implying all testimonies, or authentic accounts that have come down to us of ancient times. Antiquities may be considered as the wrecks of history, or such particulars as learned persons have collected from genealogies, inscriptions, monuments, coins, etymologies, archives, instruments, fragments of history, &c. The common division of antiquities is into sacred and profane. The former embraces whatever relates to the history of the Jewish nation; and the latter the subjects connected with political, military, literary and domestic concerns.

The most authentic information on points relating to sacred antiquities is to be obtained from the writings of the Old Testament; the works of Josephus, Shuckford, Prideaux, Godwin, Meusel, Ugolino, and Lowth's Lectures on Hebrew Poetry. On profane antiquity, Potter's Antiquities of Greece, Adams's Roman Antiquities, Horsley's Britannia Romana, and the Itinerary of Antoninus Camden, will be found amply sufficient.

ANTIRRHINUM, SNAPDRAGON, OR CALVES-SNOUT: a genus of the angiospermia order, belonging to the didynamia class of plants; and in the natural method ranking under the 40th order, personatæ. The essential characters are these; the calyx consists of five leaves: the basis of the corolla is bent backwards, and furnished with pectoria; the capsule is bilocular. There are fifty-two species of the snapdragon; it is an old inhabitant of our gardens, and we have hardly yet a more beautiful flower. The scarlet and crimson kinds are particularly fine.

ANTISCII, in geography, people who live on different sides of the equator, whose shadows at noon are projected opposite ways; the people of the north are antiscii to those of the south.

ANTISTROPHE, among lyric poets, that part of a song and dance in use among the ancients, which was performed before the altar, in returning from west to east, in opposition to strophe.

ANTITHESIS, in rhetoric, a contrast drawn between two things, which serve as shades to set off the opposite qualities of each other.

ANTOECI, in geography, an appellation given to those inhabitants of the earth who live under the same meridian, but on different sides of the equator, and at equal distances from it: the antoeci having the same longitude, and equal degrees of latitude, one north and the other south: their hours of day and night are the same, but they have opposite seasons, of course the longest day to the one is the shortest to the other.

ANTONOMASIA, in rhetoric, a figure by which the proper name of one thing is applied to several others; or, on the contrary, the name

of several things to one. Thus we call a cruel person a Nero; and we say the philosopher to denote Aristotle.

ANVIL, an iron instrument, on which smiths hammer or forge their work, and usually mounted on a firm wooden block. A forged anvil is reckoned better than one of cast work.

AORTA, in antomy, called also arteria magna, a large artery arising with a single trunk from the left ventricle of the heart above its valves, called semilunares, which serves to convey the mass of blood to all parts of the body. See ANATOMY.

APACTIS, in botany, a genus of the dodecandria monogynia class and order. The essential character is, cor. four-petalled; cal. none. There is only one species, a tall tree, a native of Japan.

APARGIA, a genus of the class and order syngenesia polygamia æqualis. The essential character is, cal. subimbricate, with linear, parallel, unequal scales; down plumose, subsessile; recept. naked, subvillose. There are seven species, much resembling the dandelion, with which they were formerly confounded.

APATITE, phosphate of lime. This mineral occurs in tin veins, and is found in Cornwall and Germany. Colours white, green, blue, and red of various shades. The primitive form of its crystals is a regular six-sided prism. Specific gravity between 2.8 and 3.2. When laid on ignited coals it emits a green light, and is almost entirely soluble in nitric acid. By rubbing it shews signs of electricity.

APETALOUS, among botanists, an appellation given to such plants as have no flower-leaves, or corolla.

APEX, in antiquity, the crest of a helmet, out more especially a kind of cap worn by the flamens.

APHÆRESIS, in grammar, a figure by which a letter or syllable is cut off from the beginning of a word.

APHANES, a genus of the monogynia order, and tetrandria class of plants; and in the natural method ranking under the 35th order, senticosæ. The essential characters are: the calyx is divided into eight parts; there is no corolla; the seeds are two, and naked. There is only one species.

APHELIUM, or APHELION, in astronomy, is that point in any planet's orbit, in which it is farthest distant from the sun; being that end of the greater axis of the elliptical orbit of the planet, most remote from the focus wherein the sun is.

APHIS, in entomology, the *puceron*, *vine-fretter*, or *plant-louse*, an extensive genus of the hemiptera order.

Of this very curious insect there are said to be thirty-three species, each of which is attached to a particular plant. They were formerly ranked among the animals which had been classed with the true Androgynes; but Mr. Bonnet has determined their division into males and females. This he did by shutting up a young aphis at the instant of its birth, in perfect solitude which yet brought forth in his sight 95 young ones. Repeated experiments, in this respect, as far as the fifth or sixth generation, all uniformly presenting the observer with fecund virgins, were communicated to the Royal Academy of Sciences; when an unforeseen and very strange suspicion, imparted by Mr. Trembley, to Mr. Bonnet, engaged him anew in a series of experiments. Mr. Bonnet therefore reared to the amount of the tenth generation of solitary aphides, and had the patience to keep an account of the days and hours of the births of each generation. In short, it was discovered, that they are really distinguished by sexes; that there are males and females amongst them, whose amours are the least equivocal of any in the world: that the males are produced only in the tenth generation, and are but few in number: that these, soon arriving at their full growth, copulate with the females: that the virtue of this copulation serves for ten generations; that all these generations, except the first, (from the fecundated eggs) are produced viviparous; and all the individuals are females, except those of the last generation, as already observed.

APHYLLANTHES, LEAFLESS FLOWER OR BLUE MONTPELIER PINK: a genus of the monogynia order, belonging to the hexandria class of plants; and in the natural method ranking under the 5th order, tetrapetaloidæ. In character it differs not from the juncus or rush, but in having a calyx of six petals, whereas the juncus has no calyx. There is only one species; viz.

APHYLLANTHES *Montpeliensis*, a native of France.

APIARY, a place where bees are kept, which should be properly defended from high winds, as well as from poultry, hogs, &c. whose dung is extremely offensive to the bees.

APIS, the *Bee*, in natural history, a genus of insects of the order hymenoptera. The mouth is furnished with jaws, and an inflected proboscis, with two bivalve sheaths; wings flat or without plaits; the sting in the female and neutral insects concealed. There are fifty-five species, of which the most remarkable are. 1. *Apis Brasilianorum*, or pale red hairy bee, with the basis of the thighs black: it is large, and a native of America.

2. APIS *cariosa*, is a yellowish hairy bee; it generally builds in rotten trees, and is found in different parts of Europe.

3. APIS *centuncularis*, the leaf cutter, or black bee, has its belly covered with yellow down. The nests of this species are made with leaves curiously plaited like a mat; they dig into the ground and build their nests, some of which are of the size and form of a thimble inserted one within another, and composed of leaves principally the rose leaf.

4. APIS *dentata*, or shining green bee, with black wings, and a kind of teeth on the hind thighs. The tongue of this bee is as long as its body.

5. APIS *ferruginea*, or smooth black bee, with the feelers, mouth, belly, and feet, of an iron colour. This is a small bee, and supposed to be of an intermediate kind between the bee and wasp. It is a native of Europe.

6. APIS *florisomnis*, or black bee, with a cylindrical incurvated belly, having two tooth-like protuberances at the anus, and a kind of prickles on the hind legs. This bee sleeps in flowers; whence the name.

7. Apis *lapidaria*, or red hairy bee, with a yellow anus, builds in holes of rocks.

8. Apis *muscorum*, or yellow hairy bee, with a white belly, builds in mossy grounds. The nests of this species are constructed of moss, in a very curious manner, and protected from the effects of the weather by an arched covering of wax.

9. Apis *rostrata* is distinguished by the upper lip being inflected and of a conical shape, and by the belly being invested with blueish belts. They build their nests in high sandy grounds, and there is but one young in each nest.

10. Apis *terrestris* is black and hairy, with a white belt round the breast, and a white anus; it builds its nest very deep in the earth.

11. Apis *variegata:* the breast and belly are variegated with white and black spots; the legs are of an iron colour. This species is not common in England, but has been found near Bexley, in Kent. It sleeps in the flower of the spotted crane's bill.

12. Apis *violacea* is a red bee, and very hairy, with blueish wings. The violacea is said to perforate trees; and hollow them out in a longitudinal direction; they begin to build their cells at the bottom of these holes, and deposit an egg in each cell, which is composed of the farina of plants, and honey, or a kind of gluten.

13. Apis *mellifica*, the domestic honey bee. This wonderful insect requires to be described under the distinct heads of queen, drone, and working bee. The drones may easily be distinguished from the common or working bees: they are both larger and longer in the body: their heads are round, their eyes are full, and their tongues short. The form of the belly differs from those of both queen and common bees; and their colour is darker than either. They have no sting, and they make a much greater noise when flying, than either the queen or the common bees; a peculiarity of itself sufficient to distinguish them. If a hive is opened in the beginning of spring, not a single drone will be found in it; from the middle of May till the end of June, there will be found commonly from 200 or 300 to 1000; but from August to the following spring it would be in vain to seek for them. They go not out till 11 in the morning, and return before six in the evening. But their expeditions are not those of industry. Their rostrum and feet are not adapted for collecting wax and honey, nor indeed are they obliged to labour. They only hover upon flowers to extract the sweets.

There appears to exist a diversity of opinion among writers on bees respecting the office of the drones. It is asserted by some highly respectable authors that the drone exists in the hive merely for the purpose of impregnating the eggs of the queen after they are deposited in the cells.

This opinion, however, Mr. Bonnet proves to be erroneous, and informs us that the queen stands in no need of the assistance of the drones to fecundate her eggs; and affirms that she lays eggs which produce young bees, without the slightest communication with the drones. This position he supports by the testimony of several other writers, particularly that of Schirach.

According to Mr. Bonnet, the queen is easily distinguished by her form, size, and colour. She is longer, and her wings are shorter in proportion to her body, than those of the other bees. The wings of the common bees and of the drones cover their whole bodies, while those of the queen scarcely reach beyond the middle. Her hinder part is more tapering, her belly and legs are yellower, and her upper parts are darker than those of other bees. The queen bee is furnished with a sting, but is extremely sparing in the use of it: so much so that one may handle her, and even teaze her without provoking her resentment.

The common bees, says Mr. Bonnet, are endowed with the powerful faculty of raising a queen bee from an egg in a common cell. For this purpose they choose a common cell with an egg in it, and inject into it a white liquid matter from their proboscis; they then build on the edges of the cell and enlarge it. On the fifth day the royal maggot appears in the form of a semicircle, and floats about on the top of the liquid matter, or swims in the midst of it; and on the seventh day the cell is sealed up. During this period the maggot undergoes various metamorphoses, but still having no resemblance to a bee, till the 14th or 15th day, when instead of the gross maggot there appears a charming young queen bee.

When a queen dies, the bees of her hive immediately cease working, consume their own honey, fly about their own and other hives at unusual hours, when other bees are at rest, and pine away if not soon supplied with another sovereign. Her loss is proclaimed by a clear and uninterrupted humming. This sign should be a warning to the owner of the bees to take what honey remains in the hive, or to procure them another queen. In this last case the flock instantly revives, and pleasure and activity are apparent through the whole hive. The dissection of the queen bee shows evidently that she lays many thousand eggs. It is computed that the ovaria of a queen bee contain more than 5000 eggs at one time; and therefore it is not difficult to conceive that a queen bee may produce 10,000 or 12,000 bees, or even more, in the space of two months.

The working or common bee, is smaller than either the queen or the drone bee. They have four wings fastened to their middle part, by which they are not only enabled to fly with heavy loads, but also to make those well-known sounds and hummings to each other, which are supposed to be their only form of speech.

The honey-bladder of the bee when full, is about the size of a small pea, and is so transparent that the colour of the honey may be distinguished through it. The sting, which is hollow and horny, is connected to the belly by certain small muscles, by which the bee can dart it out, and draw it in with great force and quickness. It is about the 6th part of an inch in length, largest at the root, and tapering towards the point. The wound proves mortal to numerous insects; and the loss of the sting is accompanied by death to the bee herself, as it generally draws after it part of her entrails.

There are some curious instances on record of the command which some persons have obtained over bees. Mr. Wildman informs us that he caused swarms to light where he pleased

almost instantaneously: he ordered them to settle on his head, then removed them to his hand, and commanded them to depart and

has taught me, that as soon as I turn up a hive, and give it some taps on the sides and bottom, the queen immediately appears to know the cause of this alarm; but soon retires again among her people. Being accustomed to see her so often, I readily perceive her at first glance; and long practice has enabled me to seize her instantly, with a tenderness that does not in the least endanger her person. When possessed of her, I can without injury to her, or exciting that degree of resentment that may tempt her to sting me, slip her into my other hand, and, returning the hive to its place, hold her there, till the bees missing her, are all on wing, and in the utmost confusion. When the bees are thus distressed, I place the queen wherever I would have the bees to settle. The moment a few of them discover her, they give notice to those near them, and those to the rest; the knowledge of which soon becomes so general, that in a few minutes they all collect themselves round her; and are so happy in having recovered this sole support of their state, that they will long remain quiet in their situation. Nay, the scent of her body is so attractive of them, that the slightest touch of her, along any place or substance, will attach the bees to it, and induce them to pursue any path she takes."

When the bees begin to work in their hives, they divide themselves into four companies, one of which roves in the fields in search of materials; another employs itself in laying out the bottom and partitions of their cells; a third is employed in making the inside smooth from the corners and angles; and the fourth company brings food for the rest, or relieves those who return with their respective burdens. But they are not kept constant to one employment; they often change the tasks assigned them; those that have been at work being permitted to go abroad, and those that have been in the fields already take their places. They seem even to have signs by which they understand each other; for when any one of them wants food, it bends down its trunk to the bee from whom it is expected, which then opens its honey-bag, and lets some drops fall into the other's mouth, which is at that time opened to receive it. Their diligence and labour are so great, that, in a day's time, they are able to make cells, which lie upon each other, numerous enough to contain 3000 bees.

The habitations of bees ought to be very close; and what their hives want from the negligence or unskilfulness of man, these animals supply by their own industry. For this purpose they make use of a resinous gum, which is more tenacious than wax, and differs greatly from it. This the ancients called *propolis*. It will grow considerably hard in the hive, though it will in some measure soften by heat, and is often found different in consistence, colour, and smell. It has generally an agreeable aromatic odour when it is warmed; and by some it is considered as a most grateful perfume. When the bees begin to work with it, it is soft; but it acquires a firmer consistence every day, till at length it assumes a brown colour, and becomes much harder than wax.

Bees anxiously provide against the entrance of insects into the hive, by gluing up with wax or propolis the smallest holes in it. Some stand as sentinels at the mouth of the hive, to prevent insects of any kind from getting in. But if a snail or other large insect should get in, notwithstanding all resistance, they sting it to death, and then cover it over with a coat of propolis, to prevent the bad smell or maggots which might proceed from the putrefaction of such a large animal.

Bees are particularly sensible of the approach of stormy weather; and on such occasions they are sometimes seen hurrying to the hive in such numbers that the doors of their habitations are too small to admit them. When a hive has become too crowded, a part of the bees single out a young queen, go in quest of a new habitation, and having found one, they instantly set to work to procure materials for building and food with great diligence; and they are said to produce more wax during the first fortnight, than they do all the rest of the year.

The balls which we observe attached to the legs of bees returning to the hives, are not wax, but a powder which the bee collects by rolling itself in the cup of the flower on which it rests, and which it afterwards brushes off with its hind legs, kneads into balls, eats, and by digestion forms into wax. When this substance is not all wanted, it is laid up in repositories to be kept in store, and is known by the name of bee-bread.

The materials of which bee-hives are made should be such as to secure as far as possible the health and comfort of the bees. Long experience has established the general superiority of the common straw hives, although it must be confessed that single boxes have several advantages which straw hives have not. When the bees require more room it is easily afforded by adding a few rolls to the lower part of the hive. Particular attention is requisite in the choice of stock-hives. In September every stock-hive should contain as much honey as will furnish a supply of food for the bees till June. They ought also to be full of combs, and should weigh about 30lb. each.

Bees generally first swarm in May; and seldom before ten o'clock in the morning, or after three in the afternoon. Just before swarming, an unusual silence may be observed in the hive; after this, as soon as one takes flight, they all follow. As soon as the swarm settles, the bees must be got into the new hive as speedily as possible, to prevent their taking flight again. During the winter season the bees are in a lethargic state, hence little food supports them; but as they frequently revive in a warm sunny day, the hive should be provided with a plate of fine honey, covered with a piece of paper having holes in it, through which the bees may feed without daubing themselves.

In abstracting the honey from the hive, it is common in this country to suffocate the bees with the fumes of burning sulphur; but although this practice is strenuously supported by many, it is obviously cruel, and, in every respect, unnecessary, and at variance with the laws of economy.

The situation of an apiary is a matter of very

great importance. It should face the south, and have the advantage of as uniform a temperature as possible; it is convenient to have it near the house, but it should not be within the sphere of offensive smells, or liable to the rapacity of vermin. Hornets are particularly hostile to bees, and will do the hive great injury if suffered to intrude. On this account it is recommended by writers on bees, to destroy their nests, and thus, as far as can be done, to rid the vicinity of such formidable enemies.

APIUM, PARSLEY, in botany, a genus of the digynia order, belonging to the pentandria class of plants; and in the natural method ranking under the 45th order, umbellatæ. The fruit is oval, and streaked; the involucrum consists of one leaf, and the petals are inflected. There are only two species, the culture of which is well known, viz. 1. Apium graveolens, or smallage, or celery, a native of England; and, 2. Apium petroselinum, or common parsley, a native of Sardinia.

Smallage, when improved by culture, is termed celery, and there is scarcely a more desirable root, especially as it is a winter sallad. It is aperient and tonic.

With respect to the 2d sort, the roots and seeds of the petroselinum are used in medicine. The root of parsley is one of the five aperient roots; if liberally used, it is apt to occasion flatulencies; and thus, by distending the viscera, produces a contrary effect to that intended by it; the taste of this root is somewhat sweetish, with a light degree of warmth and aromatic flavour.

APLANATIC, a term applied to that kind of refraction which entirely corrects the aberration of the rays of light, and the colour depending on it, in contradistinction to the word achromatic, in which there is only a partial correction of colour.

APLUDA, a genus of the monœcia order, belonging to the polygamia class of plants; and in the natural method ranking under the 4th order, gramina. The calyx is a bivalved gluma: the floscules of the female are sessile, and the male floscules are furnished with pedunculi; the female has no calyx; the corolla has a double valve; there is but one stylus, and one covered seed. The male has three stamina. There are 4 species.

APOCYNUM, in botany, a genus of the pentandria digynia class and order. Corolla campanulate; nectareous filaments five, alternating with the stamina. There are 14 species.

APOGEE, in astronomy, that point in the orbit of a planet, or the sun which is farthest from the earth. This term properly belongs to the ancient astronomy, which was much taken up in ascertaining the apogee and perigee: modern astronomers have laid aside these terms, and instead of them use the terms aphelium and perihelium.

APOLOGUE, in literature, an ingenious method of conveying instruction under a feigned relation, called a moral fable. The fables of Æsop are a model of this kind of writing.

APOPLEXY, a distemper in which the patient is suddenly deprived of the exercise of all the senses, and of voluntary motion; while a strong pulse remains with a deep respiration, attended with a stertor, and the appearance of a profound sleep.

APOSTROPHE, in rhetoric, a figure by which the orator addresses a person either absent or dead as if he was present; or appeals to angels and to men, to rocks, groves, &c. Thus Adam in Milton's Paradise Lost

> O woods, O fountains, hillocks, dales, and bowers,
> With other echo, &c.

APOTHECARY, one who practises the art of pharmacy. In London, the apothecaries are one of the city companies, and by an act which was made perpetual in the ninth year of George I. are exempted from serving upon juries, or in ward and parish offices. They are obliged to make up their medicines according to the formulas prescribed in the college dispensatory, and are liable to have their shops visited by the censors of the college, who are empowered to destroy such medicines as they think not good.

APPARATUS, a term used to denote a complete set of instruments, or other utensils, belonging to any artist or machine: thus we say, a surgeon's apparatus, a chemist's apparatus, the apparatus of the air-pump, microscope, &c.

APPARENT, among mathematicians and astronomers, denotes things as they appear to us, in contradistinction from real or true: thus we say, the apparent diameter, distance, magnitude, place, figure, &c. of bodies.

APPEAL, in law, the removal of a cause from an inferior to a superior court or judge, when a person thinks himself aggrieved by the sentence of the inferior judge. Appeals lie from all the ordinary courts of justice to the house of lords.

APPEARANCE, in law, signifies a defendant's filing common or special bail, on any process issued out of a court of judicature.

In perspective, appearance is the projection of a figure or body on the perspective plane.

In astronomy it signifies the same as phænomena, or phases; and in physiology, the same as phasmata.

APPELLATIVE, in grammar, a noun, or name, which is applicable to a whole species or kind, as man, horse; in contradistinction to a proper name.

APPELLOR, or APPELLANT, in law, he who has committed some felony, or other crime, which he confesses, and appeals, that is, accuses his accomplices.

APPENDANT, in law, any thing that is inheritable, belonging to some more worthy inheritance; as an advowson, common, or court, may be appendant to a manor, land to an office, &c. but land cannot be appendant to land, for both are corporeal inheritances, and one thing corporeal cannot be appendant to another.

APPLICATION, signifies the act of applying one thing to another by bringing them nearer together: thus a longer line or space is measured by the application of a less; and motion is determined by the successive application of any thing to different parts of space. The term is used in the operations of arithmetic, geometry, &c.

APPLICATION of one science to another, signifies the use that is made of the principles of the one for augmenting and perfecting the other. Thus algebra has been applied to geometry, and vice versa, and both are made use

of in illustrating and demonstrating the principles of mechanics, astronomy, navigation, &c. See GEOMETRY.

APPOINTEE, in heraldry, the same as aguisée; thus we say, a cross appointée, to signify that which has two angles at the end cut off, so as to terminate in points.

APPORTIONMENT, in law, the division of a rent into parts, in the same manner as the land out of which it issues is divided: for example, if a person leases three acres of land for a certain rent, and afterwards grants away one acre thereof to another: the rent shall be apportioned between them.

APPOSITION, in grammar, the placing two or more substantives together, in the same case, without any copulative conjunction between them; as, *ardebat Alexin delicias domini.*

APPRAISING, the valuing or setting a price on goods. This is usually done by a sworn appraiser, who, if he values the goods too high, is obliged to take them at the price appraised.

APPREHENSION, in logic, the first or most simple act of the mind, whereby it perceives, or is conscious of some idea: it is more usually called perception.

APPRENTICE, a young person bound by indenture to some tradesman, in order to be instructed in the mystery or trade. By the laws of England, a master may be indicted, for not providing for, or for turning away his apprentice; and upon complaint from a master that he neglects his duty, an apprentice may be committed to Bridewell, or be bound over to the sessions. By 5 Eliz. no person can exercise any trade in any part of England, without having served a regular apprenticeship of at least seven years. No trades, however, are held to be within the statute but such as were in being at the making of it in the reign of Elizabeth.

APPROACHES, in fortification, the works thrown up by the besiegers, in order to get nearer a fortress, without being exposed to the enemy's cannon: such, in a more particular manner, are the trenches, which should be connected by parallels, or lines of communication.

APPROPRIATION, the annexing a benefice to the proper and perpetual use of a religious house, bishopric, college, &c. Where the king is patron, he may make appropriations himself; but in other cases, after obtaining his licence in chancery, the consent of the ordinary, patron, and incumbent is requisite. Appropriations cannot be assigned over, but those to whom they are granted may make leases of the profits There are in England 2845 impropriations.

APPROVER, in law a person, who being indicted of treason or felony, for which he is not in prison, confesses the indictment; and being sworn to reveal all the treasons and felonies he knows, enters before the coroner his appeal against all his partners in the crime.

APPROXIMATION, in arithmetic and algebra, the coming nearer and nearer to a root or other quantity sought, without expecting to be ever able to find it exactly. There are several methods for doing this, to be found in mathematical books, being nothing but infinitely converging series, some approaching quicker, others slower towards the truth.

By such an approximation the value of a quantity may be found, though not to the utmost degree of exactness, yet sufficiently so for practice. Thus $\sqrt{2}=1.41421356$, &c. $=$ the approximating series $1+\frac{4}{10}+\frac{1}{100}+\frac{4}{1000}+\frac{2}{10000}+$, &c. or supposing $x=10$, equal to the series $1+\frac{4}{x}+\frac{1}{x^2}+\frac{4}{x^3}+\frac{1}{x^4}+,=1+4x^{-1}+x^{-2}+4x^{-3}+2.\ ^{-4}+$, &c.

APPULSE, in astronomy, the approach of a planet towards a conjunction with the sun, or any of the fixed stars.

APPURTENANCES, in common law, signify things corporeal and incorporeal, that appertain to another thing as principal; as hamlets to a manor, and common of pasture and fishery.

APSIS, in astronomy, a term used indifferently for either of the two points of a planet's orbit, where it is at the greatest or least distance from the sun or earth. Hence the line connecting these points is called the line of the apsides.

APTENODYTES, in ornithology, a genus of birds that seems to hold the same place in the southern parts of the world a[illegible] do in the northern. According to [illegible] this is the genus penguin. It is seen only in the temperate and frigid zones on that side of the equator which it frequents.

APTERA, in the Linnæan system of zoology, the seventh and last order of insects, the distinguishing characteristic of which is, that the insects comprehended in it have no wings: such are the louse, the flea, the podura, the monoculus, the acarus, the spider, the scorpion, and the crab.

AQUAFORTIS. This name is given to a weak and impure nitric acid, commonly used in the arts. It is distinguished by the terms *double* and *single*; the single being only half the strength of the other. The artists who use these acids call the more concentrated acid, which is much stronger even than the double aquafortis, *spirit of nitre*. This distinction appears to be of some utility, and is therefore not improperly retained by chemical writers.

AQUA *Regia*. This acid is now termed by chemists nitro-muriatic acid, being composed of a mixture of the nitric and muriatic acids.

AQUEDUCT, a construction of stone or timber, on an uneven tract of country, to preserve the level of water, and to convey it from one place to another. Some of the aqueducts built by the Romans were very magnificent; that constructed by Louis XIV. for carrying the Bucq to Versailles is 7000 fathoms long, with 2560 fathoms of elevation, and contains 242 arcades.

AQUARIUS, in astronomy, a constellation which makes the eleventh sign in the zodiac, marked thus, ♒. It consists of 45 stars in Ptolemy's Catalogue, of 41 in Tycho's, and in the Britannic Catalogue, of 108.

AQUEOUS *humour*, or the watery humour of the eye, it is the first and outermost, and that which is less dense than either the vitreous or crystalline. It is transparent and colourless like water, and fills up the space that lies between the cornea and the crystalline humour.

AQUILLARIA, a genus of the class and order decandria monogynia. The essential character is, calyx five cleft; corolla, none;

nectary, pitcher-shaped, half five cleft with bifid clefts: capsula superior, woody, too celled, two valved: seeds solitary.

produced by a disease in this tree, which finally kills it.

AQUILEGIA, COLUMBINE, in botany, a genus, of the pentagynia order, belonging to the polyandria class of plants; and, in the natural method, ranking under the sixteenth order, multisiliquæ. It has no calyx; the petals are five, with a horn-like nectarium inserted between each; and there are five separate capsules. There are five species.

ARABIC (GUM). This is reckoned the purest of gums, and does not greatly differ from gum Senegal, vulgarly called gum seneca, which is supposed to be the strongest, and is on this account, as well as its greater plenty and cheapness, mostly used by calico printers and other manufacturers. The best is of a white colour. It is good in fluxes and catarrhs; and is used for painting in water colours. [illegible] gums of the plum and the cherry-tree [illegible]rly the same qualities as gum arabic. All these substances faciliate the mixture of oils with water.

ARABIS, *bastard tower-mustard*; a genus of the siliquose order, belonging to the tetradynamia class of plants; and in the natural method ranking under the 39th order, siliquosæ. The generic mark consists in [illegible] nectiferous glands which lie on the inside of each leaf of the calyx. There are 21 species, but none of them remarkable.

ARACHIS, in botany, the ground nut, a genus of the diadelphia decandria class; the flower is papilionaceous, having three petals; the fruit is an oblong pod, contracted in the middle. There are two species which grow in Peru, Brazil, and Carolina; it furnishes a considerable article of food for the negroes.

ARACHNOIDES, in zoology, a name given to those *echini marini*, or sea hedgehogs, which are of a circular form, but variously indented at the edges.

ARALIA, in botany a genus of plants with rosaceous flowers, and succulent berries, containing each a single oblong, and hard seed. It belongs to the *pentandria pentagynia* class of Linnæus. There are nine species, most of them shrubs, and natives of China and America; some are hardy enough to stand our climate in sheltered situations.

ARANEA, in natural history, the *spider*, a genus of insects of the order aptera. The mouth is furnished with short horny jaws; lip rounded at the apex; feelers two, incurved, jointed, very acute at the tip, clubbed with the genitalia in the male; no antennæ; the eyes are eight, or rarely six; feet eight, the anus furnished with papillæ, or teats for spinning. They fix the ends of their threads by applying these nipples to any substance, and the thread lengthens in proportion as the animal recedes from it. They can stop the issuing of the threads by contracting the nipples, and reascend by means of the claws on their feet, much in the same manner as sailors warp up a rope. Naturalists enumerate upwards of fifty species of aranea, the most remarkable of which are the following

1. Aranea Aquatica, or water-spider, frequents the fresh waters of Europe: it is amphibious. In the water its belly appears cover-

its body, and prevent the immediate contact of the water. This bubble of air is made the substance of its dwelling, which it constructs under water: for it fixes several threads of fine matter, to the stalks of plants in the water; and then ascending to the surface, thrusts the hinder part of its body above water, drawing it back again with such rapidity, that it attaches underneath a bubble of air, which it has the art of detaining under water, by placing it underneath the threads, and which it binds like a covering around the air bubble. Then it ascends for another air bubble; and thus proceeds until it has constructed a large aerial apartment under water. It lodges during the winter in empty shells, which it shuts up with a web.

2. Aranea Avicularia is a native of America, and feeds upon small birds, insects, &c. The bite of this spider is accounted as venomous as that of the serpent.

3. Aranea Calycina lives in the cups of flowers, and catches bees and flies.

4. Aranea Cucurbitina has a globular yellow belly, with a few black spots. It lives in the leaves of trees, and encloses its eggs in a soft net.

5. Aranea Diadema is the largest spider this country produces. The abdomen is of an oval form, downy, and of a ruddy yellow colour. The upper part is adorned with black and white circles and dots, having a longitudinal band in the middle, composed of oblong pearl-coloured spots. The legs are of a pale green colour, annulated with dark purple or black. It inhabits the birch tree.

6. Aranea Fasciata, with yellow bands round the belly, and dusky rings on the legs, is a native of Barbary; and is as large as the thumb.

7. Aranea Fimbriata has a black oblong belly, with a white line on each side, and dusky coloured legs. It lives in water, upon the surface of which it runs with great swiftness.

8. Aranea Holosericea has an oval belly covered with a down, like velvet; at the base, or under part, it has two yellow spots. It is found in the folded leaves of plants.

9. Aranea Labyrinthica, with a dusky oval belly, and a forked anus. The web of this species is horizontal, with a cylindrical well or tube in the middle.

10. Aranea Ocellata has three pair of eyes [illegible] its thighs. It is about the size of the tarantula, of a pale colour, with a black ring round the belly, and two black spots on the breast. It is a native of China.

11. Aranea Saccata lives in the ground, and carries a sack with its eggs, wherever it goes. This sack it glues to its belly, and will rather die than leave it behind.

12. Aranea Tarantula has the breast and belly of an ash colour; the legs are likewise ash coloured, with blackish rings on the under part: two of its eyes are larger than the other, red, and placed in the front; four other eyes are placed in a transverse direction towards

the mouth. It is a native of Italy, Cyprus, Barbary, and the East Indies. The tarantula is the largest of all the European spiders; but the extraordinary symptoms of sickness difficulty of breathing, faintness, &c. which are supposed to ensue from the bite of this insect, as well as their supposed cure by the power of music alone are now exploded, as fabulous.

There is one particular in the history of spiders that deserves attention, viz. their power of flight. In the autumnal season they ascend the air, and fill it with that infinity of floating silky threads which are so conspicuous at that season of the year. When inclined to make these excursions, the spider ascends some eminence, as the top of a wall, or the branch of a tree; and turning itself with its head towards the wind, ejaculates several threads, and rising from its station, commits itself to the gale, and is thus carried far beyond the height of the loftiest towers. When satisfied with their journey and their prey, they suffer themselves to fall by contracting their limbs, and gradually disengaging themselves from the thread that supports them.

ARBITER, in civil law, is a judge appointed by the magistrate, or chosen by the parties at variance, to decide their differences according to law. There is a difference between an arbiter and an arbitrator; the former must judge according to the usages of the law, but the latter is allowed a discretionary power.

ARBITRATION, a power given by two or more contending parties to some person, or persons to determine the dispute between them: if the two do not agree, it is usual to add that another person be called as umpire, to whose sole judgment it is then referred. The submission to arbitration is the authority given by the parties in controversy to the arbitrators, to determine and end their grievances; and this being a contract or agreement, must not be strictly taken, but largely, according to the intent of the parties submitted.

ARBITRATOR, a private extraordinary judge, chosen by the mutual consent of parties, to determine controversies between them. Arbitrators are to award what is equal between both parties, and the performance must be lawful and possible. An action of debt may be brought for money adjudged to be paid by arbitrators.

ARBUTUS, the strawberry-tree, in botany, a genus of the decandria monogynia class of plants. The essential character is, calyx five parted; corolla ovate, diaphanous at the base: capsule five celled. The fruit is a roundish berry, containing five cells, and is edible. There are ten species.

ARC, in geometry, part of the circumference of a circle lying between two points, by which the quantity of the whole circle, or line, or something else sought may be found.

ARCH *of equilibration* is that which is in equilibrium in all its parts, having no tendency to break in one part more than in another, and which is therefore safer and stronger than any other figure. Every particular figure of the extrados, or upper side of the wall above an arch, requires a peculiar curve for the under side of the arch itself, to form an arch of equilibration, so that the incumbent pressure on every part may be proportional to the strength or resistance there. When the arch is equally thick throughout, a case that can hardly ever happen, then the catenarian curve is the arch of equilibration; but in no other case; and therefore it is a great mistake in some authors to suppose that this curve is the best figure for arches in all cases; when in reality it is commonly the worst. This subject is fully treated in Dr. Hutton's Principles of Bridges, prob. 5.

ARCS, *equal*, those which contain the same number of degrees, and whose radii are equal.

ARC, *diurnal*, that part of a circle described by a heavenly body, between its rising and setting; as the nocturnal arch is that described between its setting and rising; both these t[illegible]r are always equal.

[illegible]c *of progression* or *direction*, an arch [illegible]he zodiac, which a planet seems to pass [illegible]r, when its motion is according to the [illegible]ns.

ARCHERY, the art of shooting with a bow and arrow; an art of which the English have always been reckoned fond, and in which they have excelled. Many of the ancient kings greatly encouraged the practice of archery. Hence Edward III. ordered a complaint to be lodged against the sheriff of London, for permitting other useless games to be pursued, when the leisure time of his people upon holidays ought to be spent in the recreations of archery. In the reign of Edward IV. an act was made that every Englishman should have a bow of his own height to be made of yew, hazel, ash, &c.: and mounds of earth were ordered to be made in every township, and the inhabitants to practise archery, under certain penalties.

The Artillery Company of London are the remains of the ancient fraternity of bow men, or archers. There are several companies of archers in England, as the Woodmen of Arden; and in Scotland there is the Royal Company of Archers, which consists of upwards of 1000 members, among whom are most of the Scottish nobility.

ARCHIL, a moss of a grey colour, which grows on the rocks in many parts of the Archipelago, and on the western coast of England. It yields a purple tincture, fugitive indeed, but very beautiful, which is the best chemical test for acids and alkalis, and is known by the name of tincture of litmus. By the addition of tin it is rendered durable as a dye, and it then approaches to scarlet. Archil however is most commonly used to give a bloom to pinks and other colours. It readily gives out its colouring matter to water or any spirit.

ARCHITECT, a person skilled in architecture, or the art of building; who forms plans and designs for edifices, conducts the work, and directs the artificers employed in it. A thorough knowledge of mathematics, is an indispensable qualification in an architect; he should also be expert in perspective drawing.

ARCHITECTURE, is the art of building, or the science which teaches the method of erecting buildings, either for habitation, defence, or ornament. It is an art of the first necessity, and almost coeval with the human species. Man, from seeking shade and shelter under the trees of the forest, soon felt the necessity and saw the utility of bending them to more commodious forms than those in which

he found them disposed by nature. To huts made of trees and branches leaning together at top, and forming a conical figure plastered with mud, succeeded more convenient, square, roofed habitations; the sides of these habitations, and the inner supports of the cross beams of the roofs, being trunks of trees; from them were derived those beautiful, symmetrical columns, *the Orders of Architecture.*

Although this art was cultivated by the ancient Egyptians, Assyrians, and Persians, yet the Greeks justly claim the honour of having raised the first structures in which elegance and symmetry were combined with comfort and convenience in the plan.

The established five orders of architecture, the Tuscan, the Doric, the Ionic, the Corinthian, and the Composite, were brought to perfection under the Greeks and Romans. Modern efforts have added little or nothing to the beauty and symmetry of these columns, and the parts dependent on them; but much has been done in the internal improvement of mansions and houses.

OF THE FIVE ORDERS.

The Tuscan Order.

Although there are no ancient remains of it, this order is generally placed first on account of its plainness; and Vitruvius only mentions in an indistinct manner the general proportions of it. The Trajan and Antonine columns at Rome are commonly called Tuscan, though they have eight diameters for their height, and the torus and capitals do not exhibit Tuscan plainness. It is probable the Tuscan is only a simplification of the Doric, of which there are so many ancient remains; but to Tuscany it evidently owes its name.

Its proportions are, fourteen modules or seven diameters for the height of the column; three modules and a half for the whole entablature, which divided into ten equal parts, three are for the height of the architrave, three for the frize, and four for the cornice: the capital is in height one module. The base, including the lower cincture of the shaft, is one module; and the shaft, is twelve modules. For interior use the height of the column may be fourteen modules and a half, or fifteen modules, and the increase may be in the column only.

The Doric Order.

The origin of this order is ascribed to Dorus, who built a temple to Juno, in the ancient city of Argos. But afterwards, Ion, who built a temple to Apollo in Asia, fixed the proportions of it; and being guided by the example of nature in the structure of man, gave six times the length of the foot, or diameter of its base, for the height.

The practice of the moderns allows eight diameters, with a base; an addition no less useful than elegant. Some of the most ancient columns of this order are fluted, and some squared off.

The place and form of the triglyph, an ornament peculiar to this order, are both evidently derived from the ends of projecting joints, laid from the inner to the outer walls of buildings. When as much of the timber as appeared unhandsome was cut off, tablets like the triglyphs now in use, were fastened on the ed ends, and produced a pleasing effect. The triglyphs, interjoists, and metope, in Doric work, had their origin from the disposition of the timbers in the roof: afterwards, in other works, some made the rafters that were perpendicular over the triglyphs to project outward, and carved their projecture; hence as the triglyphs arose from the disposition of the joists, so the mutules under the corona were derived from the projecture of the rafters; wherefore, in stone or marble structures, the mutules are represented declining, in imitation of the rafters; and also on account of the droppings from the eaves, it is proper they should have such declination. The skull of the ox is peculiar to the Doric order.

According to the modern proportions of this order, the height of the column, including its capital and base, is sixteen modules, the height of the entablature four modules, which being divided into eight parts, two are for the architrave, three for the frize, and three for the cornice · the base will be one module in height, the capital thirty-two minutes, or little more.

The Ionic Order.

Vitruvius ascribes this order to Ion mentioned above, but it is more probable that it had its origin from the people of Ionia. The Ionic column is more slender than the Doric, but more graceful. Its ornaments are elegant, and in a style between the richness of the Corinthian, and the plainness of the Tuscan. The general appearance of it is simple, yet graceful and majestic, whence figuratively it has been compared to a female, rather decently than richly clad, whose locks of hair decorated with flowers, are represented by the volutes of the capital, ornamented with festoons. When Hermogenes built the celebrated temple of Bacchus, at Teos, he rejected the Doric, after the marbles had been prepared, and adopted the Ionic in its stead. And, indeed, the difficulties of adjusting the mutules, metope, and triglyphs in Doric buildings, together with the heavy appearance of that order, naturally would cause the Ionic to be preferred. Denteles, which are peculiar to this order, represent the assers, or small rafters that support the tiles: on the ancient Ionic columns, and volutes are usually placed parallel. and to Michael Angelo is ascribed the executing them on an angular plan, though it is certain that some remains of antiquity furnish similar examples. The modern proportions are: eighteen modules for the height of the column, and four modules, or four and a half, for the entablature. The capital is twenty-one minutes, and the base thirty minutes in height; the shaft may be plain, or fluted with twenty, or twenty-four flutings, whose plan should be a little more than a semi-circle, and the breadth of the fillet between them, one third of the flute. The ornaments of the capital are to correspond with the flutings of the shaft, and there must be an ove above the middle of each fluting. The entablature being divided into ten equal parts, three are for the architrave, three for the frize, and four for the cornice. In interior work, where delicacy is required, the height of the entablature may be reduced to one fifth of the height of the column.

The Corinthian Order.

The Corinthian order, which is the finest of

all the orders, has evidently arisen from the two former, having nothing peculiar to itself except the capital, the origin of which is given under the word Abacus. Scamozzi calls it the virginal order, from the delicacy, tenderness, and beauty of the whole composition. The most correct specimens of this order that remain in existence are to be collected from the Stoa, the arch of Adrian, the monument of Lysicratus at Athens, the Pantheon of Agrippa and the three columns of the Campo Vaccino at Rome, particularly the last.

The modern proportions of this order are the following: twenty modules for the height of the column; the entablature, five modules; the base one module, and may be either Attic or Corinthian. The capital is seventy minutes in height; the proportion in the entablature, is the same as in the Tuscan and Ionic orders. If the entablature is enriched, the shaft of the column may be fluted, and the flutings may be fitted to one third part of their height with cabling; and in rich decorations, the cabling may be composed of reeds, husks, ribbons, flowers, &c.

The capital is enriched with olive-leaves, as are almost all the antiques of this order at Rome; the acanthus being seldom employed, but in the Composite. The entablature may be reduced to two-ninths or one-fifth of the height of the column: in which case it is best to use the Ionic entablature, or reduce the denteles of the cornice.

The Composite Order.

In a successful attempt at pleasing variety and novelty, the Romans produced the composite order, by combining the proportions and enrichments of Corinthian, with the angular volute of the Ionic.

The omission of the upper row of leaves in the capital, and the addition of the Ionic volute, give it a bolder aspect than the Corinthian; uniting elegance and a very pleasing projection. In the triumphal arches of Rome, erected at the height of its splendour, it was used with a happy effect, as well as in many other examples in that city.

The height of the column is twenty modules, according to modern proportions; that of the entablature five modules; the capital is seventy minutes in height. The base measures the same as in the Doric and Ionic orders; and as the module is less, all its parts will be more delicate. The shaft may be enriched with twenty or twenty-four flutings, and the principal members of the entablature may have the same proportions as in the two former orders.

Different Parts of an entire Order.

Every order consists of three divisions; the pedestal, the column, and the entablature. The *pedestal* consists of a base or plinth, the dado, and the cornice. The pedestal is used to elevate the column to a necessary height. The *column* includes a base, a shaft, and a capital. The *entablature* consists of an architrave, a frize, and a cornice. The *plinth* is so called from a brick or flat square stone, on which columns, in the early state of architecture, were originally placed. The *dado*, or *die*, is so called from being of the form of a cube. The *cornice* is from corona a top, or summit. The *base* of the column is its foundation. The *shaft* is that straight part of a column, comprehended between the base and capital, resembling a pillar The *capital* is so denominated from caput, the head; the *abacus* is the upper member of the column, and serves as a covering. The *architrave* is so called from two Greek words, signifying, "principal beam," on account of the architrave being the principal support to the entablature. The *frize* is a large flat face, which was sometimes enriched with the figures of animals, and is so called from a Greek word signifying a fringe or border.

Some of the smaller members are, (1.) The *torus*, which is the swell above the plinth. (2.) The *astragal*, a small round member in the form of a ring, which terminates the extremities of the column. (3.) The *scotia* is a hollow moulding used in bases, and receives its name from the strong shadow produced by the concavity. Each column has its particular *base*; the Tuscan base is the most simple, having only a torus and a plinth: the Doric has an astragal more than the Tuscan. To the Ionic base the torus is larger on a double scotia, with two astragals intervening. The Corinthian base has two toruses, two scotias, and two astragals. In the Composite base, there is one astragal less than in the Corinthian. *Corona* is a large flat member in a cornice used to screen the under parts, and to prevent the rain from running down the column. The name of *soffit* is given to the under part of the corona.

The diminution of Columns.

Columns are generally diminished one-sixth part of their lower diameter, which diminution begins at one third part of their height. Some architects allow a small swell in the lower part of the middle division of the pillar.

But in columns from fifteen to twenty feet high, the lower diameter being divided into six parts and a half, take five parts and a half for the diameter at the top. Columns from twenty to thirty feet high are diminished one-seventh. From thirty to forty feet, the lower diameter being divided into seven parts and a half, six and a half may be taken for the upper diameter; and from forty to fifty feet high, they may be diminished one-eighth part, and so on in proportion.

Pedestals, Pilasters, &c.

Pedestals consist of three principal parts, the base, the die, and the cornice. No particular proportions can be assigned for them; but it is common to give them from one-third to one quarter of the height of the column and entablature, which being divided into nine parts, two are for the base, one for the cornice, and six for the die, which is of equal dimensions with the plinth of the column. One pedestal is sufficient for two columns placed together, and a continued pedestal with projections in the cornice, under each column, must be used for a colonnade or peristyle.

Pilasters follow in their parts the orders of columns, and admit of a like diminution, but are square instead of round in their plan.

Pilasters are employed in internal decorations to save room, and seldom project beyond the solid wall, above one quarter of their diameter; and sometimes they are seen on the external part of buildings alone, and also with columns. When placed behind, and very

near columns they need not project above one eight part of their diameter.

Attics.—In Athens, where it was for many ages a rule to conceal the roofs of buildings, attics had their origin. A line of low columns and pedestals, or of columns and balusters, may be employed for this purpose. They should be less in height than one-third of the order in which they are placed, but not lower than one-quarter. If the attic is composed of a low order, the base and cornice may have the same mouldings as the pedestals of the columns, and with the die, bear the same proportion to each other; and when they form pilasters over the columns of the building, the breadth of the bases must not exceed the upper diameter of the columns which they surmount.

Caryatides.—Representations of the human figure, the male called Persians, and the female Carians, or Caryatides, have been employed to support the entablatures of buildings. These were invented and used in memory of the captivity of the Persians and Carians by the Anthenians. The Persians may be of any size, with a Doric entablature, bearing the same proportion to the figure as to columns of the same height; but the Caryatides, or female figures, ought to have Ionic or Corinthian entablatures, and not to be larger than life.

Gothic Architecture.

Gothic is a general term for that architecture which was formerly used in England and on the continent. But the ancient buildings in this country are more accurately divided into *Saxon, Norman,* and *Saracenic.* When the Romans invaded Britain, they found no places corresponding with our ideas of a city, or town. Dwellings, like those of the ancient Germans, were scattered over the country, and generally situated on the brink of a rivulet, for the sake of water, or on the skirt of a wood or forest, for the purpose of hunting and providing for their cattle. These inviting circumstances being more conspicuous in some parts of the country than in others, the princes and chiefs selected the most agreeable spots for their residence.

When the Romans began to form settlements and colonies in this island, a sudden and remarkable change took place in the style of architecture. They not only built a considerable number of solid, convenient, and magnificent edifices for their own accommodation but also exhorted and instructed the Britons to follow their example. Soon after this, however, architecture, and the arts connected with it, began sensibly to decline in Britain. This arose, perhaps, partly from the building of Constantinople, which attracted the most celebrated architects to the east; but the almost total ruin and neglect of architecture in this island, may doubtless be attributed to the final departure of the Romans. The natives, and the descendants of Roman and British parents, having neither skill nor courage to defend their numerous towns, forts, and cities, suffered them to be plundered and destroyed by their ferocious invaders, the Scots, Picts, and Saxons; who, having no taste for the arts, committed the most wanton and extensive devastations.

The *Saxon* architecture was the Roman architecture in a decayed state. The Saxons having the Roman buildings continually before their eyes, employed workmen to build their edifices in a similar manner.

The characteristics of Saxon architecture, are, the semi-circular arch, and short, thick, massive columns. It has no pinnacles or pointed ornaments, no delineations of arms, nor statues, except in relief. The best specimen of this style is the north transept of Winchester Cathedral.

The *Norman* architecture differs from the Saxon chiefly in its increased proportion, and in the magnitude and massiveness of its buildings. arches highly ornamented with figures of angels, fruit, animals, &c.—Subjects serious and ludicrous promiscuously blended together walls without buttresses, arches supported by solid, clumsy pillars, with a regular base and capital; the capitals adorned with carvings of foliage and animals; the columns with small half columns joined to them, the surfaces ornamented with spirals, squares, network, and figures in relievo.

Saracenic or *Gothic Architecture,* the marks of which are its numerous and prominent buttresses, its lofty spires and pinnacles, its large and ramified windows, its ornamented niches and canopies, the sculptured saints and angels, the delicate lace-work of its fretted roofs, and an indiscriminate profusion of ornaments. But its most distinguishing characteristics are the small clustered pillars; and pointed arches, formed by the segments of two intersecting circles.

Florid Gothic. On the death of Eleanor, wife of Edward I. in 1290, this monarch, to show respect to the memory of his queen, caused a magnificent cross to be erected at every spot, where her body and the funeral procession halted. Most of these crosses have since been destroyed;—they were profusely decorated with sculptured ornaments. Those at Northampton, Geddington, and Waltham, are the most perfect which yet remain. This kind of workmanship was particularly adapted, by its richness, for screens and altar-pieces, and the lesser parts of the Gothic structure. Elaborate canopies, ornamented pinnacles, and octagonal niches and stalls were introduced, with the crocket ornament stealing up the angle, till the pyramidal point was crowned with a larger flower, or pine-apple,—while pendant decorations of fruits, flowers, and emblazonry were seen in all parts. Sculptures of small imageries were introduced in the fretted roofs of the principal aisles and chancel.

Modern Architecture.

Gothic architecture began to decline from the time of Henry VIII. A style in which the Grecian and Gothic were mixed together then prevailed, but in the sixteenth and seventeenth centuries the chaste architecture of the Greeks and Romans was revived. The first improvements took place in Italy, whence they passed into other parts of Europe; and though the Italians were long accounted the first architects, England produced Inigo Jones and Sir Christopher Wren, who hold the most exalted station.

The banqueting-house at Whitehall queen Katherine's chapel at St. James's; the piazza of Covent Garden, and many other public

buildings are monuments of the taste and skill of Inigo Jones.

The churches, royal courts, stately halls, magazines, palaces, and public structures designed by Sir Christopher Wren, are proud trophies of British talent. If the whole art of building were lost, it might be again recovered in the cathedral of *St. Paul*, and in that grand historical pillar called the *Monument*. To these we superadd *Greenwich Hospital, Chelsea Hospital, the Theatre at Oxford, Trinity College Library, and Emmanuel College, Cambridge;* the churches of *St. Stephen in Walbrook, St. Mary-le-bow, and* FIFTY-TWO *others in London*, serve to immortalize his memory. While we contemplate these, and many other public edifices erected and repaired under his direction, we are at a loss which most to admire—the fertile ingenuity, or the persevering industry of the artist.

The architectural history of the eighteenth century differs from that of preceding ages in two essential circumstances.

1. The *public* buildings, erected during this period, are, in general, not so grand and massive as those of some former periods. But while they fall short of splendour and magnificence, they are superior to most ancient structures in simplicity, convenience, neatness, and elegance.

2. *Private Dwellings* have been made more spacious, convenient, and agreeable to a correct taste, than in any preceding period. The liberal use of *glass*, in modern buildings, contributes greatly to their beauty and comfort, and is a point in which the ancients were totally deficient. In descending to the various minute details of human dwellings, especially those which have reference to elegance and enjoyment, it is obvious the artists of the eighteenth century exceed all others.

ARCTIC, in astronomy, an epithet given to the north pole; and likewise to a circle of the sphere, parallel to the equator, and 23 degrees 28 minutes distant from the north pole.

ARCTIUM, the *burdock*, in botany, a genus of the syngenesia polygamia æqualis class of plants; the common calyx of which is globose and imbricated; the compound flower is tubulated and uniform, with equal hermaphrodite corollulæ: the proper flower is monopetalous and tubulous, with a slender and very long tube; there is no pericarpium; the cup is connivent, and the seed single, vertically pyramidical, and crowned with a simple down shorter than the seed. There are two species; *viz.* the Laffa and Bardana.

ARCTOMYS, the *marmot*, a genus of quadrupeds differing very little from that of mus. The generic character is; front teeth two in each jaw, strong, sharp, and cuneated; grinders in the upper jaw, five on each side; in the lower jaw four; clavicles or collar bones perfect. They are diurnal animals; feed on roots, grain, and fruits, which they often collect in heaps. They reside in subterraneous holes, and become torpid in the winter. The head is gibbous, or rounded, with short ears, or none; body thick; tail short; hairy; fore feet four-toed, with a very short thumb; hind feet five-toed; cœcum large. There are eleven species, of which the following are the most remarkable. 1. Arctomys marmota, or Alpine marmot: ears short, round; body brown, beneath reddish. It inhabits dry open places, on the summits of the Alps and Pyrenees; feeds naturally on roots, herbs, and insects; when tamed it will eat any thing that is offered; drinks little; basks in the sun; lives among small tribes, with a centinel placed to give notice of danger, which is done with a hiss; forms a burrow with many chambers and entrances, for the summer; another lined with soft grass, in which it remains torpid during winter; it eats with its fore paws; walks on its heels, often erect; is easily caught when out of his burrow; in a tame state very destructive of food, clothes, furniture, &c.; and in winter kept awake with difficulty, even in warm rooms. 2. Marmot Quebec, is rather larger than a rabbit, with short ears and a round head. It inhabits Hudson's Bay and Canada. 3. Monax, or Maryland marmot, is found in various parts of North America, and in its habits and manners resembles that already noticed. The marmot when taken young may be easily domesticated, and is often taught to play numerous monkey-like tricks. 4. Arctomys Bobac, or grey marmot, this species is of the size of the Alpine marmot, and is found in Poland, Russia, and among the Carpathian hills. 5. Citillus, or variegated marmot, is the most beautiful of all the species. It inhabits Bohemia and other parts of Germany, from the banks of the Wolga to India and Persia, through Siberia and Great Tartary to Kamschatka, and even the continent of America. It is not certain that these sleep in the winter, like others of the Arctomys genus. They breed in the spring, and produce from five to eight at a time. They are said to be irascible and quarrelsome among themselves, and their bite is very severe. They feed not only on animal food, but on small birds and other animals, which they will kill. They are easily tamed, and will grow familiar in a few days. They [illegible] extremely clean, and after feeding, generally wash their faces, and clean their fur.

ARCTOPUS, in botany, a genus of the polygamia diœcia class of plants, the general umbel of which is long and unequal; the partial umbel is shorter; the involucra consist of five leaves; the corolla of five petals; the fruit is single and bilocular, and stands under the receptacle of the floscule; the seed is single, cordated, and acuminated. There is but one species.

ARCTOTIS, in botany, a genus of the polygamia necessaria order, belonging to the syngenesia class of plants; and in the natural method ranking under the 49th order, compositæ discoites. The receptacle is bristly; the coror of the pappus is pentaphyllous; and the caly is imbricated with scales loose at the top There are 11 species; natives of Ethiopia, o the Cape of Good Hope.

ARCTURUS, a star of the first magnitud in the skirt of Bootes, so called from its bein near the tail of the bear. It is supposed to be the nearest fixed star to our system visible in the northern hemisphere.

ARDEA, the HERON, a genus of the order of grallæ. The general characters of this order are: the bill is straight, sharp, long, and compressed, with a furrow from the nostrils to the point; the nostrils are linear, and the feet have four toes. Under this genus Lin

næus comprehends the grus or crane, the ciconia or stork, and the ardea or heron. There are 79 species, of which the following are the most remarkable.

1. Ardea Americana, or hooping crane of Edwards, is a native of America. The crown of the head and temples are naked and papillous; the forehead, nape of the neck, and prime wing feathers, are black, but the body is white. They lay two white eggs, and sit 20 days.

2. Ardea argil, or hurgil, of Ives, is a very large species; from tip to tip of the wings, measuring 14 feet 10 inches, and from the tip of the bill to the claws 7 feet and a half; the bill is 16 inches round at the base, of different colours, and of a triangular shape; the feathers of the back and wings are of an iron colour, those of the breast long; over the belly a great deal of down, of a dirty white; the legs and half the thighs are naked; the naked parts full three feet in length. This monster inhabits Bengal. On opening one of these, a terapin, or land-tortoise, 10 inches long, was found in its craw, and a large male black cat was found entire in its stomach.

3. Ardea ciconea, or white stork of Ray, has naked eye-balls, and black prime winged feathers. The skin below the feathers, as also the beak, feet, and claws are of a blood-colour. It is a native of Europe, Asia, and Africa, and feeds upon amphibious animals. It is such an enemy to serpents, that it is reckoned almost a crime to kill a stork. From this favourable treatment, they are seen in Holland and the Low Countries walking unconcerned in the middle of the streets.

4. Ardea garzetta, or egret, is crested behind; the body is white, the beak black, and the feet greenish. It is a most elegant bird. It weighs about one pound, and the length is 24 inches, to the end of the legs 32. It is a native of the East; but was once common in Britain.

5. Ardea grus, or common crane, has a naked papillous crown; the prime feathers of the wings are black; the body is ash-coloured. This species is met with in great flocks throughout northern Europe and Asia. They feed on reptiles of all kinds, as well as on green corn.

6. Ardea herodias, or cristata maxima of Catesby, is crested behind, has a dusky-coloured back, reddish thighs, and the breast speckled with black. It is four feet and a half when erect: is a native of Virginia, and feeds upon fish, frogs, lizards, &c.

7. Ardea leucogeranos of Pallas, or the Siberian crane of Pennant, is four feet and a half when erect. The bill is red, the irides are white; the plumage is white as snow, except the ten first greater quills, with the coverts of them which are black; the legs are long and red. This species inhabits the marshes and lakes in Siberia. It makes its nest among the reeds, and lays two ash-coloured eggs, spotted with brown.

8. Ardea major, or common heron, has a black crest depending from the back part of the head, an ash-coloured body, and a black line on the neck and breast. It is a native of Europe. It builds in trees, and sometimes in high cliffs near the sea, commonly in company with others, like rooks. It was formerly in this island game; heron-hawking being a favourite diversion of our ancestors.

9. Ardea pavonia, or the crowned crane, has an erect bristly crest, with the temples and two wattles naked. It is a native of the coast of Guinea, and remarkably tame.

10. Ardea stellaris, or the bittern, has a smooth head, and is varigated through the body with dark coloured spots of different sizes. It is a native of Europe and inhabits the fen countries. It flies principally about the dusk of the evening, and rises by a spiral ascent, till it is quite out of sight. The food of the bittern is chiefly frogs. Its flesh has the flavour of the hare, and nothing of the fishiness of that of the heron.

11. Ardea violacea, or crested bittern of Catesby, has a white crest; the body is variegated with black and white, and bluish below. These birds are found in Carolina during the rainy seasons, and are called crab-catchers.

12. Ardea virgo has a straight greenish bill and crimson irides. The crown of the head is ash-coloured; the rest of the head, the upper and all the under parts, to the breast, black: the back, and all the under part from the breast, of a bluish ash-colour; behind each eye springs a tuft of long white feathers, which decline downwards. It is found in many parts of Asia and Africa.

ARECA, in botany a genus of plants, the characters of which are not perfectly ascertained; the calyx of the male flower is a bivalve spatha, the spadix is ramose; the corolla consists of three acuminated petals; the stamina are nine filaments, of which the three exterior ones are the longest; the female flowers are in the same spadix and spatha; the corolla is like the male corolla; the fruit is a sub-oval fibrose drupe surrounded at the base with an imbricated calyx, and containing an oval seed.

There are three species, of which the oryzæformis is the cabbage-tree of the East Indies. The oleracea is found in the West Indies, the green tops of which are cut and eaten as a cabbage.

ARENA, among the Romans, was a place where the gladiators fought; and was so called from being strewed with sand, for the purpose of concealing from the view of the spectators, the blood spilt in the combats.

ARENARIA, *sand-wort*, in botany, a genus of the decandria trigynia. Calyx five-leaved, spreading; petals five, entire; capsule superior, one-celled, many seeded. There are 36 species.

ARENARIUS, the name of a book of Archimedes, in which is demonstrated, that not only the sands of the earth, but even a greater quantity of particles, than could be obtained in the immense sphere of the fixed stars, might be expressed by numbers, in a way invented and described by himself.

AREOPAGUS, or ARÆOPAGUS, in Grecian antiquity, a sovereign court at Athens, so famous for the justice and impartiality of its decrees, that the gods themselves are said to have submitted their quarrels to its determination.

ARETHUSA, in botany, a genus of the gynandria diandria class; and in the natural method ranking under the seventh order, orchideæ. The generic character is taken from the nectarium, which is tabular, situated at the bottom of the corolla, and the inferior labium

fixed to the stylus. There are seven species, all natives of America.

ARETIA, in botany, a genus of the pentandria monogynia class; and in the natural method ranking under the 21st order, preciæ. The corolla is divided into five parts; the tube of the corolla is ovated; and the capsule is globular, and consists but of one cell. There are three species.

ARGENT, in heraldry, the white colour in the coats of gentlemen, knights, and baronets; the white in the arms of the sovereign princes is called luna, and that in the arms of the nobility, pearl: this is expressed in engraving, by the parts being left plain, without any strokes from the graver. See HERALDRY.

ARGONAUTA, in natural history, a genus of worms, of the order testacea. Animal a sepia or clio; shell univalve, spiral, involute membranaceous, one-celled. There are five species. A. argo has the keel, or ridge of the shell slightly toothed on each side; it inhabits the Mediterranean and Indian oceans, and is the famous nautilus, supposed in the early ages of society to have first taught men the use of sails. When it means to sail it discharges a quantity of water, by which it is made lighter than the sea, and rising to the surface, erects its arms and throws out a membrane between them, by which means it is driven forward like a vessel under sail; two of the arms it hangs over the shell, to serve as oars or a rudder. The shell is white or yellowish, with smooth or knotty striæ, or ribs, which are sometimes forked; the keel is generally brownish.

ARGUMENT, ARGUMENTUM, in rhetoric and logic, an inference drawn from premises, the truth of which is indisputable, or at least highly probable.

ARGUMENT, in astronomy, denotes a known arch, by means of which we seek another one unknown.

The argument of the moon's latitude is her distance from the node; and the argument of inclination is an arch of a planet's orbit, intercepted between the ascending node and the place of the planet from the sun, numbered according to the succession of the signs of the zodiac.

ARGUS-SHELL, a species of porcelain-shell, beautifully variegated with spots resembling, in some measure, those in a peacock's tail.

ARGYTHAMNIA, in botany, a genus of the class and order monoecia tetrandria; the essential character is, male cal. four-leaved; cor. four-petalled; fem. cal. five leaved, cor. none, styles dichotomous, caps. nicoceous, solitary seeds. There is one shrubby species, a native of Jamaica.

ARIES, in astronomy, a constellation of fixed stars, drawn on the globe in the figure of a ram. It is the first of the twelve signs of the zodiac, from which a twelfth part of the ecliptic takes its denomination. It is marked thus ♈, and consists of sixty-six stars.

ARISTA, among botanists, a long needle-like beard, which stands out from the husk of a grain of corn, grass, &c.

ARISTOLOCHIA, BIRTHWORT, a genus of the hexandria order, belonging to the gynandria class of plants; and in the natural method ranking under the 11th order, sarmentaceæ. It has no calyx; the corolla consists of one entire petal; and the capsule, which is below the flower, has six cells. There are 27 species, mostly foreign.

ARITHMETIC, *theoretical*, is the science of the properties, relations, &c. of numbers, considered abstractedly, with the reasons and demonstrations of the several rules. Euclid furnishes a theoretical arithmetic, in the seventh, eight, and ninth books of his Elements.

ARITHMETIC, *practical*, is the art of numbering or computing; that is, from certain numbers given, of finding certain others, whose relation to the former is known. As, if two numbers, 10 and 5, are given, and we are to find their sum, which is 15, their difference 5, their product 50, their quotient 2.

A treatise on arithmetic without numerous examples for practice under each rule, could be of little or no use in a work of this description. And as the limits to which we are necessarily confined expressly forbid the introduction of such an article, we shall confine our observations to a few particulars that will, we doubt not, be found of essential service to those who are employed in teaching, as well as to those who are studying this important branch of mathematical science.

And first, let it be observed, that as no person can ever rise to eminence, either in science or in the various departments of commerce, without being an expert practical arithmetician, it is of the utmost consequence that a broad and solid foundation be laid in the introductory parts of this branch of knowledge. Before the pupil proceeds to the simplest operations in addition he ought to practise numeration until he can, without difficulty, read lines of figures of considerable length. These the teacher ought to vary according to the progress of the scholars. The most effectual method of conducting this process is to write the lines of figures with chalk, on a board painted black, which ought to be suspended on the wall at a convenient height, and the pupils, being ranged in order before it, should, in succession, read the whole. At first, the lines should be divided into the proper periods by pointing; but after a little practice this will be found to be unnecessary. When the pupils have become expert in notation, let them proceed to simple addition, which may be taught with the most effect, and in the least time, by a similar process. It will be found of great advantage for each of the scholars to copy from the board, on his own slate, the examples exhibited for practice, which should consist of as many figures as can be conveniently and distinctly arranged on one side of a common sized slate. In writing down these examples for the exercise of his pupils, the teacher will find it of importance so to place the figures that those which are the most difficult to be added may come together. After the same manner the rules of subtraction, multiplication, and division, may be taught, but the pupil ought, on no account, to leave any rule until he can with ease perform the most difficult examples that can be proposed to him under it. When the four rules above mentioned have been acquired in their simple form, the pupils should be taught the use of the arithmetical signs, and, for some time, exercised in promiscuous examples which involve their application to the extent of the progress they have made in these rules.

Proceeding thus through the first four rules in their application to compound quantities, the young arithmetician will find himself fully prepared to enter on the rules of proportion, practice, interest, &c.: and, understanding what he is engaged in, will be delighted with the results of his own operations; and what is of still greater consequence, will speedily become qualified to transact the business of the counting-house with accuracy and dispatch.

Various expedients have been devised for preventing youth in schools from the too frequent practice of employing their school-fellows, for a trifling reward, to perform their arithmetical calculations for them; but the plan here recommended has been found by experience to be the most effectual. It is, indeed, attended with more personal labour, on the part of the master, than either rewards or punishments; but for this he is amply repaid by the pleasure of witnessing the progress of even the dullest and the idlest of his pupils.

With respect to the most suitable works on arithmetic to be put into the hands of young persons, it may be observed, that almost any one of those now in general use will, with the assistance of a good teacher, answer the end proposed. Perhaps, for common purposes, the late editions of Walkinghame's "Tutor's Assistant," which are much improved, will be found sufficient. Dr. Hutton's, and Mr. Bonnycastle's works on this subject are entitled to high commendation, and may be perused with great advantage by those who desire to obtain a knowledge of the more difficult operations in arithmetic; but in this respect Keith's "Complete Practical Arithmetician" stand's unrivalled.

If the student is desirous of prosecuting vulgar and decimal arithmetic to their utmost extent, and in their application to annuities, mensuration, gauging, &c. he will find ample satisfaction from the excellent work of Mair: and if an historical and philosophical acquaintance with the subject be required, Professor Leslie's "Philosophy of Arithmetic," will be found to yield much curious and valuable information.

There is an excellent work on arithmetic for the use of schools, by the late Rev. J. Joyce, who recommends the teaching of fractions and logarithms along with the simpler parts of vulgar arithmetic; and certainly no good reason can be shewn why this plan should not to be adopted, since with proper explanation, they may be rendered perfectly simple. But whatever treatise may be adopted, it is recommended as an indispensable requisite to general success, that the pupils be frequently exercised in promiscuous examples, and at stated periods, examined on the arithmetical tables, which they ought to commit to memory.

ARITHMETICAL *complement of a logarithm*, the sum or number which a logarithm wants of 10,000000: thus the arithmetical complement of the logarithm 8.154032 is 1.845968.

ARMORY is a branch of the science of heraldry, consisting in the knowledge of coats of arms, as to their blazons and various intendments.

ARMOUR denotes all such habiliments as serve to defend the body from wounds, especially of darts, a sword, a lance, &c. A complete suit of armour formerly consisted of a helmet, a shield, a cuirass, a coat of mail, a gauntlet, &c. all now laid aside.

ARMS, in general, all kinds of weapons, whether used for offence or defence.

ARMY, a number of soldiers, consisting of horse and foot, provided with artillery, &c. under the command of a general, having lieutenant-generals, major-generals, brigadiers, and other officers under him. An army consists of squadrons and battalions, and is usually divided into three corps, and formed into three lines: the first line is called the van-guard, the second the main body, the third rear-guard, or body of reserve. The middle of each line is occupied by the foot: the cavalry forms the right and left wing of each line; and sometimes squadrons of horse are placed in the intervals between the battalions. When the army is drawn up in order of battle, the horse are placed at the distance of five feet from each other, and the foot at three. In each line the battalions are distant from each other about 180 feet, which is nearly equal to their length in front; and the same holds with regard to the squadrons, which are about 300 feet distant, the extent of their own front.

ARNOPOGON, a genus of the syngenesia æqualis class and order. Receptacle naked; down feathery, on a pedicel; calyx one-leafed, eight-parted, turbinate. There are four species.

AROMA, is that part of odorous bodies which affects the organs of smell, and is supposed by some to be a peculiar principle.

ARRAC, a spirituous liquor imported from the East Indies, and obtained by distillation from rice or sugar, fermented with the juice of cocoa-nuts.

ARRAIGNMENT, in law, the arraigning or setting a thing in order; as a person is said to arraign a writ of novel disseisin, who prepares and fits it for trial. It is most properly used to call a person to answer in form of law upon an indictment, &c. at the suit of the king.

ARREST, the apprehending and restraining a person, in order to oblige him to be obedient to the law; which in all cases, except treason, felony, or breach of the peace, must be done by virtue of a precept out of some court. Outer doors may be broken open to arrest a felon; but in civil cases it is otherwise, unless it is in pursuit of one before taken.

ARRONDE'E, in heraldry, a cross, the arms of which are composed of sections of a circle: not opposite to each other, so as to make the arms bulge out thicker in one part than another; but the sections of each arm lying the same way, so that the arm is everywhere of an equal thickness, and all of them terminating at the edge of the escutcheon like the plain cross.

ARSENAL, in military affairs, in a large and well fortified town, is a spacious building, in which are deposited all kinds of arms, and other warlike implements such as cannon, mortars, howitzers, small arms, and every other warlike kind of engines and instruments of death.

ARSENIC, is generally found in combination with sulphur, oxygen, and many of the metals. When reduced to its pure metallic

state, it is a friable, brilliant metal, of a bluish white colour, easily tarnishing, that is, oxydizing, by exposure to the air. In all its states it is poisonous. Arsenic is used to whiten copper, and it enters into most of the compositions for the specula of reflecting telescopes and for other optical purposes. Its oxyds are employed in many processes of the dyer, also as fluxes for glass, and in several of the arts. The sulphurets of arsenic form valuable pigments of different colours.

ART *and Part*, in the law of Scotland, is applied to an accomplice.

The facts inferring art and part need not be particularly laid in the libel or indictment, for these general words, as terms of stated signification, are sufficient. Yet these facts may be set forth, and it is proper so to do, if the prosecutor chooses to confide in the court rather than in the jury. Also in the criminal letters, the persons of the accomplices must be described by proper names and designations.

ARTEDIA, a genus of the digynia order, and pentandria class of plants, in the natural method ranking under the 45th order, umbellatæ. The involucra are pinnatifid: the floscules of the disc masculine; and the fruit is hispid with scales. There is but one species.

ARTEMISIA, MUGWORT, SOUTHERNWOOD, and WORMWOOD, a genus of the polygamia superflua order, and syngenesia class of plants, and in the natural method ranking under the 49th order, compositæ nucamentaceæ. The receptacle is either naked or a little downy; it has no papus; the calyx is imbricated with roundish scales; and the corolla has no radii. These are 44 species, of which the following are the most remarkable.

1. Artemisia abrotanum, or southernwood, which is kept in gardens for its agreeable scent.

2. Artemisia absinthium, or common wormwood, grows naturally in lanes and uncultivated places.

3. Artemisia arborescens, or tree-wormwood, grows naturally in Italy and the Levant, near the sea. It rises six or seven feet high, sending out many ligneous branches.

4. Artemisia dracunculus, or tarragon, is used in sallads, especially by the French, and is a hardy plant, spreading by creeping roots.

5. Artemisia maritima, or sea wormwood, grows on the sea-coasts where there are several varieties.

6. Artemisia Pontica, or Pontic wormwood, is a low herbaceous plant; the stalks die in autumn, and new ones appear in spring.

7. Artemisia santonicum, produces the semen santonicum, which is used for worms in children. It grows in Persia, whence the seeds are brought to Europe.

8. Artemisia vulgaris, or common mugwort, grows naturally on banks and by the sides of foot-paths in many parts of Britain.

ARTERY, in anatomy, a conical tube or canal, which conveys the blood from the heart to all parts of the body. See ANATOMY.

ARTICHOKE. See CYNARA.

ARTICLE, in grammar, a particle, in most languages, that serves to express the several cases and genders of nouns, when such languages have not different terminations to denote the different states and circumstances of nouns. The Latin language has no articles; but the Greek has the article ὁ; the English, the articles *a* and *the*; the French lanugage has three articles, viz. *le*, *la*, and *les*; the Italian, *il*, *lo*, and *la*; and the German, *der*, *das*, and *dat*.

ARTICULATION, in anatomy, denotes the juncture of two bones intended for motion: there are two kinds, one called diarthrosis, the other synarthrosis, the former has a manifest, the latter only an obscure motion.

ARTIFICERS, are persons employed to work with the hands, and to manufacture any kind of commodity in iron, brass, wood, &c. Artificers are the same with what we term handicrafts and mechanics.

ARTILLERY, in the most appropriate application of the word, means the cannon, mortars, howitzers, and other large pieces, for discharging shot and shells by the expansive force of inflamed gunpowder, as used in the land service. In a more enlarged sense the word denotes engines of war of all sorts, ancient and modern, by which darts, stones, bullets, &c. were shot forth in battle.

By artillery is also meant, the science which all officers of artillery ought to possess. This science teaches the knowledge of the materials and ingredients that enter into the composition and structure of whatever relates to the artillery; the construction, &c. of the different engines of war; the arrangement, movement and management of cannon, in the field, or in sieges; and the best method of operation with the whole train taken together.

ARTILLERY, *flying*, a species of it, called so from the celerity with which it is moved from station to station.

Seats are contrived in the carriage and limbers of guns of this sort for the men who work it, and a sufficient number of horses are added to carry the whole at a gallop, when the ground will admit of this pace. Each horse is in general rode by a separate driver, and the men are all trained either to drive or work the gun, as occasion may require.

Flying artillery were first used by the French, shortly after their revolution, and materially assisted them in some of their most signal victories. Their use has now become general in Europe.

ARTOCARPUS, (from *αρτος*, bread and *καρπος*, fruit,) the BREAD-FRUIT TREE, a genus of the monandria order, belonging to the monœcia class of plants. It has a cylindric amentum or catkin, which thickens gradually, and is covered with flowers: the male and female in a different amentum. In the male, the calyx is two-valved, and the corolla is wanting. In the female, there is no calyx or corolla: the stylus is one, and the drupa is many-celled. This remarkable tree, according to the statements of Cook, Anson, and others, seems to supply the inhabitants of the places where it is cultivated with their principal article of food. It abounds in the South Sea Islands, and grows to about the size of our largest apple trees. The fruit hangs on the branches like apples, and is larger than a cocoa-nut, with a thick tough rind, and when ripe it turns yellow. It is gathered before it becomes quite ripe, and baked till the crust be-

comes quite black; when this is rasped off, there remains a loaf of bread, and the crumb is as soft and sweet as a new-baked roll. The bread-fruit tree was introduced into the West Indian Islands in the year 1793, by order of the British Government. This tree not only supplies food, but also clothing, for the bark is stripped off the suckers, and formed into a kind of cloth. To procure the fruit for food costs the Otaheiteans no trouble or labour but climbing a tree; which though it should not indeed shoot up spontaneously, yet, as Captain Cook observes, if a man plant ten trees in his life time, he will as completely fulfil his duty to his own and future generations, as the native of our less temperate climate can do by ploughing in the cold winter, and reaping in the summer's heat, as often as these seasons return; even if after he has procured bread for his present household, he should convert a surplus into money, and lay it up for his children.

ARTS, are usually divided into liberal and mechanical; the former comprehend poetry, painting, sculpture, architecture, &c.: the latter take in carpentry, masonry, &c. The *fine arts* seem to be a term adopted from what the French call *beaux arts*, which are, painting, engraving, sculpture, music, &c.

ARUM, WAKEROBIN, or CUCKOW-PINT, in botany, a genus of the polyandria order, belonging to the gynandria class of plants, and in the natural method ranking under the 2d order, piperitæ. The spatha is monophyllous, and cowl-shaped: the spadix is naked above, female below, and stamineous in the middle. There are 32 species, of which the most remarkable are the following:

1. Arum arborescens, or dumb cane, a native of the Sugar Islands and America. It has an acid juice. 2. Arum arisarium, as well as the arum proboscidium and arum tenuifolium, are all denominated friar's-cowl, from the shape of the flowers, which appear in April. 3. Arum colocasia; this, with the arum divaricatum, esculentum, peregrinum, and sagittifolium, has mild roots, which are eaten in hot countries. The leaves of the esculentum called Indian kale, are also made use of where English vegetables are not to be had. 4. Arum divaricatum has spear-shaped leaves. 5. Arum dracunculus or common dragon, grows naturally in the southern parts of Europe. The stalk is straight, and about four feet in height, and spotted like a snake, the flower, which grows at the top of the stalk, has a long spathe of a dark purple colour. 6. Arum Italicum is a native of Italy, Spain, and Portugal: the leaves are above a foot long, very large, and veined with white, interspersed with black spots. 7. Arum maculatum, or common wake robin, grows in woods, and on shady banks, in most parts of Britain. The leaves are halbert-shaped, entire, and spotted; the berries numerous. It flowers in April. The receptacle is long and club-shaped, with the seed-buds surrounding the base. The chives are fixed to the receptacle among the seed-buds, between two rows of tendrils. 8. Arum trilobalum, or Arum of Ceylon, is a native of India. It is a low plant, and the flower which rises from the root, is of a fine scarlet colour. The roots of the maculatum and dracunculus are used in medicine as stimulants and attenuants. The latter is most powerful, and is of particular benefit in rheumatic complaints.

ARUNDELIAN *marbles*, called also the Parian Chronicle, are ancient stones, on which is incribed a chronicle of the city of Athens, supposed to have been engraven in capital letters, in the island of Paros, 264 years before Christ. They take their name from the earl of Arundel, who procured them from the East, or from his grandson, who presented them to the University of Oxford.

ARUNDO, in botany, the REED, a genus of the digynia order, and triandria class of plants, and in the natural method ranking under the fourth order, gramina. The calyx consists of two valves, and the floscules are thick and downy. There are 14 species; the most remarkable are:

1. Arundo bambos, or the bamboo, a native of the East Indies and some parts of America; where it frequently attains the height of 60 feet. The main root is thick, jointed, and sends out many fibres, of a whitish colour, and many feet long. The flowers resemble those of the common reed. The young shoots are covered with a dark green bark; these when very tender afford a pickle which is esteemed a valuable condiment in the Indies. The stalks in their young state are almost solid, and contain a milky juice: but as they advance in age they become hollow, except at the joints, where they are stopped by a woody membrane, upon which this liquor concretes into a substance called tabaxir, or sugar of Mombu; which was held in much esteem by the ancients. The old stalks grow to five or six inches diameter, and are then of a yellow colour; and are so hard and durable, that they are used in buildings, and for making all sorts of household furniture; and when bored through the membranes of their joints, are converted into water-pipes. The smaller stalks are used for walking sticks; and the inhabitants of Otaheite make flutes of them.

2. Arundo donax, or cultivated reed, is a native of warm countries, but will bear the cold of our moderate winters in the open air. The stalks of these are used by weavers, as also for making fishing-rods.

3. Arundo orientalis is what the Turks use as writing pens; it grows in a valley near mount Athos, as also on the banks of the river Jordan.

4. Arundo phragmitis, or the common marsh-reed, grows by the sides of our rivers, and in standing waters.

5. The arundo versicolor, or Indian variegated reed, is supposed to be a variety of the donax, differing from it only in having variegated leaves.

AS, in antiquity, a particular weight, consisting of twelve ounces; being the same with libra, or the Roman pound.

As, was also the name of a Roman coin, which was of different matter and weight according to the different ages of the commonwealth.

It is also used to signify an integer, divisible into twelve parts, from which last acceptation it signified a whole inheritance.

ASAFŒTIDA, in chemistry, a gum resin obtained from ferula asafœtida, a perennial plant, which is a native of Persia. When the plant is about four years old, its roots are dug

up and cleaned, and from their extremity, when cut, a milky juice exudes, which soon hardens and constitutes asafœtida. It comes into this, and other countries in Europe, in small grains of different colours, hard and brittle. Its taste is acrid and bitter; its smell is strongly alliaceous and fetid. Alcohol dissolves three-fourths of this substance, and water takes up about one-fourth, if applied before the spirit. It yields an oil when distilled with water and alcohol. The specific gravity is 1.32.

ASARUM, Asarabacca, a genus of the monogynia order, belonging to the dodecandria class of plants. The calyx is trifid or quadrifid, and rests on the germen; there is no corolla; the capsule is leathery and crowned. There are three species, viz.

1. Asarum Canadense, a native of Canada. 2. Asarum Europæum, grows naturally in some parts of England. Asarum Virginicum, a native of America, has no remarkable properties.

The principal use of this plant among us is as a sternutatory.

ASBESTOS, a mineral substance of which there are five varieties, all more or less flexible.

1. *Amianthus,* occurs in fine, long, flexible, elastic fibres, of a white, greenish, or reddish colour. It is somewhat unctuous to the touch, and is slightly translucent. It melts with difficulty before the blowpipe into a white enamel. The ancients manufactured cloth from the fibres of asbestos, for the purpose, it is said, of wrapping up the bodies of the dead when exposed on the funeral pile. 2. Common asbestos occurs in masses of fibres of a dull greenish colour, and of a pearly lustre. 3. *Mountain Leather,* consists of fibres interwoven and interlaced so as to become tough; its colour is yellowish white. 4. *Mountain Cork,* or *elastic* asbestos, is opaque, has a meagre feel and appearance, not unlike cork, and is somewhat elastic. It swims on water; colours—white, grey, and yellowish brown. 5. *Mountain Wood,* Ligniform asbestos. It is usually brown, and has the appearance of wood. Although the cloth of asbestos, when soiled, is restored to its primitive whiteness by heating in the fire, yet it is found to lose a little of its weight by such treatment. Asbestos is found in Crete, Cyprus, Tartary, Egypt, the Island of Anglesea, and in some parts of Scotland.

ASCARINA, in botany, a genus of the diœcia monandria class and order. Ament filiform; no corolla. Male, anthera worm-shaped, four-grooved: female, stigmata three-lobed: drupe. One species, in the Society Isles.

ASCENSION, in astronomy, the rising of the sun or a star, or any part of the equinoctial with it, above the horizon: is either right or oblique.

Right ascension is that degree of the equator, reckoned from the beginning of Aries, which rises with the sun or a star, in a right sphere.

Oblique ascension is that degree and minute of the equinoctial, counting from the beginning of Aries, which rises with the centre of the sun or a star, or which comes to the horizon at the same time as the sun or star, in an oblique sphere.

ASCENSIONAL *difference,* the difference between the right and oblique ascension in any point of the heavens; or it is the space of time that the sun rises or sets before or after six o'clock.

ASCIDIA, in natural history, a genus of worms, of the order mollusca. Body fixed, roundish, and apparently issuing from a sheath: two apertures, generally placed near the upper end, one beneath the other. There are more than 40 species found in the sea, adhering by their base to rocks, shells, and other submarine substances. They are more or less gelatinous, and have the power of squirting out the water which they take in.

ASCII, among geographers, an appellation given to those inhabitants of the earth, who, at certain seasons of the year have no shadow: such are all the inhabitants of the torrid zone, when the sun is vertical to them.

ASCLEPIAS, *swallow-wort,* in botany, a genus of the pentandria digynia class of plants, the calyx of which is a permanent perianthium, divided into five acute and small segments; the corolla consists of a single petal, divided into five deep segments at the mouth; and its fruit consists of two follicles or vaginæ, containing a great number of imbricated seeds, winged with down. There are about 40 species.

ASCYRUM, *Peter's wort,* in botany, a genus of the polyandria order, and polyadelphia class of plants: in the natural method ranking under the twentieth order, rotaceæ. Calyx four-leaved, corolla four-petalled; filaments numerous, and having four boundaries. There are three species, 1. Ascyrum crux Andreæ. 2. Ascyrum hypericoides. 3. Ascyrum villosum: they are natives of the West Indies.

ASH. See Fraxinus.

ASHES, the earthly part of wood and other combustibles after being consumed by fire. All kinds of ashes contain an alkaline salt, and are excellent manure for cold wet grounds. They are also of use in making lixiviums or lyes for bleaching, &c.

ASPALATHUS, *African Broom:* a genus of the decandria order, and diadelphia class of plants; in the natural method ranking under the 32d order, papilionaceæ. The calyx consists of 5 divisions; the pod is oval, and contains 2 seeds. Of this genus there are 37 species; all natives of warm climates, and must be preserved in stoves by those who would cultivate them here. The rose wood, whence the oleum Rhodii is obtained, is one of the species.

ASPARAGUS, a genus of the monogynia order and hexandria class of plants; in the natural method ranking under the 11th order sarmentaceæ. The calyx is quinquepartite; the three inferior petals are bent outwards; the berry has three cells, and contains two seeds. There are 13 species; but the only one cultivated in the gardens is the common asparagus, with an upright herbaceous stalk, bristly leaves, and equal stipula. The other species are kept only for the sake of variety. The plants being raised from seed, after having acquired a period of three or four years' growth, produce proper sized asparagus, of which the same roots furnish an annual supply for many years, continuing to rise in perfection for six or eight weeks in the summer season, the shoots afterwards run up to stalks and flowers, and perfect seeds in autumn. But besides the crop raised in the summer season, it may also be obtained in perfection during the winter, and early in the spring, by the aid of hot-beds.

Asparagus is always three years at least,

from the time of sowing the seed, before the plants obtain strength enough to produce shoots of due size for the table; that is, one year in the seed-bed, and two after being transplanted, though it is sometimes three or four years after planting before they produce good full-sized shoots. But the same bed or plantation will continue producing good asparagus ten or twelve years, and even endure fifteen or twenty years. However, at that age the shoots are generally small, and the whole annual produce inconsiderable.

ASPER, in grammar, an accent peculiar to the Greek language, marked thus (῾), and importing that the letters over which it is placed ought to be strongly aspirated, or pronounced as if an *h* was joined with them.

ASPERUGO, in botany, a genus of the pentandria monogynia class of plants, the flower of which consists of one rotated petal, divided into several segments at the limb; and its calyx, which is divided like the flower-petal, contains the seeds, which are four in number, and of a roundish compressed figure. There are two species.

ASPERULA, *woodruffe*, in botany, a genus of the tetrandria monogynia class of plants, the flower of which consists of one petal, divided into four segments at the limb; and its fruit is composed of two roundish, dry berries, adhering together, in each of which is a single seed of the same roundish shape. There are eleven species. The common sweet-scented woodruffe is a native of many parts of Europe, in woods and shady places. The scent is pleasant, and when dried, diffuses an odour like that of vernal grass.

ASPHALTUM. This substance, likewise called bitumen Judaicum, or Jew's pitch, is a smooth, hard, brittle, black or brown substance, which breaks with a polish, melts easily when heated, and when pure burns without leaving any ashes. It is found in a soft or liquid state on the surface of the Dead Sea, but by age grows dry and hard. The same kind of bitumen is likewise found in the earth in other parts of the world; in China; America, particularly in the island of Trinidad; and some parts of Europe, as the Carpathian hills, France, Neufchattel, &c. Its specific gravity, according to Boyle, is 1.400, to Kirwan, from 1.07 to 1.65. A specimen from Albania, of the specific gravity of 1.205, examined by M. Klaproth, was found to be soluble only in oils and in ether.

The Egyptians used asphaltum in embalming, under the name of mumia mineralis, for which it is well adapted. It was used for mortar at Babylon.

ASPHODEL, in botany, a genus of the hexandria monogynia class of plants, the flower of which is liliaceous, consisting of a single petal, divided into six segments; and its fruit is a globose-trilocular capsule, containing a number of triangular seeds, gibbous on one side. According to Martyn there are three species.

ASPLENIUM, *milt-waste*, or *spleen-wort*, in botany, a genus of cryptogamia filices plants, the fructification of which is arranged in clusters, and disposed in form of straight lines, under the disk of the leaf. This genus comprehends 47 species.

ASSAY. There are two kinds of assaying; the one before metals are melted, the other after they are struck; the first is to bring them to their proper fineness, and the last to see that they are standard. For the first the assayers used to take 14 or 15 grains of gold and half a dram of silver, if it be for money, and 18 grains of the one and a dram of the other, if for other uses. The second assay is made of one of the pieces of money, which is cut into four parts. The quantity of gold for an assay is here six grains. Assaying is also the particular mode of examining every ore or mixed metal according to its nature with the proper fluxes, in order to discover not only what metals and the proportions of them, are contained in ores, but also the quantity of sulphur, vitriol, alum, arsenic, and other matters. *Gold* is obtained pure by dissolving it in nitro-muriatic acid, and precipitating the metal by dropping in a diluted solution of sulphate of iron; the powder which precipitates is pure gold. *Silver* is obtained pure by dissolving it in nitric acid, and precipitating it with a diluted solution of sulphate of iron. With metallurgists, the interior or mass is supposed to consist of twenty-four imaginary parts, called *carats*. Gold of twenty-four carats, means *pure* gold; the number of carats mentioned specifies the parts of pure gold, and what that number *wants* of twenty-four carats, indicates the quantity of base metal in the alloy. Gold of twelve carats, means twelve parts of gold, and twelve of another metal. Gold coins of Great Britain are of twenty-two carats *fine*; they contain therefore eleven parts of gold and one of copper. *Parting* is the separation of gold from silver when both are contained in an alloy, and is founded on the *insolubility* of gold, and solubility of silver in nitric acid.

ASSIGN, in common law, a person to whom a thing is assigned or made over.

ASSIGNEE, in law, a person appointed by another to do an act, transact some business, or enjoy a particular commodity. Assignees may be by deed or by law; by deed, where the lessee of a farm assigns the same to another; by law, where the law makes an assignee, without any appointment of the person entitled, as an executor is assignee in law to the testator, and an administrator to an intestate. But when there is assignee by deed, the assignee in law is not allowed.

ASSIGNING, in a general sense, is the setting over a right to another; and in a special sense is used to set forth and point at, as to assign an error, to assign false judgment, to assign waste; in which cases it must be shewn wherein the error is committed, where and how the judgment is unjust, and where the waste is committed.

ASSIGNMENT, is a transfer, or making over to another, of the right one has in any estate; but it is usually applied to an estate for life or years. And it differs in a lease only in this; that by a lease one grants an interest less than his own, reserving to himself a reversion; in assignment he parts with the whole property, and the assignee stands in all respects in the room of the assignor.

ASSIMILATION, in physics, is that motion by which bodies convert other bodies related to them, or at least such as are prepared to be converted, into their own substance and nature.

ASSIZE, in old law books, is defined to be 'an assembly of knights and other substantial men, with the justice, in a certain place, and at a certain time: but the word in its present acceptation is used for the court, place, or time when and where the writs and processes, whether civil or criminal, are decided by judges and jury.

ASSOCIATION *of ideas* is where two or more ideas constantly and immediately follow one another, so that the one shall almost infallibly produce the other, whether there is any natural relation between them or not.

ASSONIA, in botany, a genus of plants of the class and order monadelphia dodecandria. The essential character is, calyx double, outer one three-leaved, inner one-leafed; corolla five-petalled; filament connected in form of a pitcher, with petal-shaped straps between; style one or five; capsule five-celled; seeds not winged. There are eleven species, the principal of which is a tree growing in the Isle of Bourbon.

ASSUMPSIT, a voluntary or verbal promise, whereby a person assumes, or takes upon him, to perform or pay any thing to another.

ASSURANCE, or INSURANCE, in commerce, is a contract or engagement, by which one person becomes bound, for a specified sum, to insure, for a limited time, the property of another against certain risks to which it is exposed. The party who engages to indemnify for the loss that may be sustained, is called the insurer, or underwriter; the compensation paid for the risk, the *premium;* and the document containing the obligation, the *policy*.

Assurances are distinguished by the offices in the following manner. 1. Common assurances, which include all manner of buildings, having the walls of brick, or stone, and covered with tile, slate, or metal, wherein no hazardous trades are carried on, nor any hazardous goods deposited. 2. Hazardous assurances, or assurances on timber or plaster buildings, in which hazardous trades are carried on, and hazardous goods deposited. 3. Doubly hazardous assurances, or assurances on any of the hazardous trades carried on, or on any hazardous goods deposited in buildings of timber or plaster, &c.

Dr. A. Smith, in 1775, supposed, that taking the whole kingdom at an average, 19 houses in 20, or perhaps 99 in 100, were not insured from fire. But the case is now very different, as there is scarcely any considerable town in England which has not in it either an office of its own, or agents from the London offices for effecting assurances.

ASTER, in botany, STAR-WORT, a genus of the polygamia superflua order and syngenesia class of plants, and in the natural method ranking under the 49th order, compositi radiati. The receptacle is naked, the pappus simple, the rays of the corolla more than ten, and the calyx is imbricated. There are 60 species. All of them may be raised from seed; but the greatest part of them being perennial plants, they are generally propagated by parting their roots early in the spring. They grow best in the shade.

ASTERIA, in natural history, a beautiful pellucid gem, of variable colours as viewed in different lights: called also *oculus cati, or cat's eye.*

ASTERIA is also the name of an extraneous fossil, called, in English, the star-stone.

ASTERIAS, in natural history, *star-fish,* a genus of worms, of the order Mollusca. Body depressed, covered with a coriaceous crust, muricate, with tentacula, and grooved beneath; mouth central, five-rayed. There are more than 40 species, all inhabitants of the sea, and are marked with a rough, white, stony spot above: they easily renew parts which have been lost by violence, and fix themselves to the bottom by swimming on the back and bending the rays.

ASTEROIDS, in astronomy, a name given by Dr. Herschell to the new planets, Ceres, Juno, Pallas, and Vesta, lately discovered; and which he defines as celestial bodies, which move in orbits either of little or of considerable eccentricity round the sun, the plane of which may be inclined to the ecliptic in any angle whatsoever.

ASTHMA, in medicine, a painful, difficult, and laborious respiration, occasioned by intolerable straitness of the lungs, which, as it disturbs the free circulation of the blood through the lungs, endangers a suffocation.

This disorder is attended with violent motions of the diaphragm, abdominal and intercostal muscles, to the very scapula and pinnæ of the nostrils. It is usually divided into pneumonic and convulsive: and is also either continual, or intermitting and periodical, and returns commonly when a sober regimen is not observed.

ASTRAGAL, in architecture, a little round moulding, in form of a ring serving as an ornament at the tops and bottoms of columns. See ARCHITECTURE.

ASTRAGAL, in gunnery a round moulding encompassing a cannon, about half a foot from its mouth.

ASTRAGALUS, *milk-vetch*, in botany, a genus of the diadelphia decandria class of plants, with a papilionaceous flower, and bilocular-podded fruit, containing kidney-like seeds. There are upwards of 60 species; all of which may be raised from seeds.

ASTRANTIA, *masterwort*, a genus of the digynia order and pentandria class of plants; and in the natural method ranking under the 45th order, umbellatæ. The involucrum is lanceolated, open, equal, and coloured. The species are five, but possess no remarkable properties.

ASTROLABE, an instrument for taking the altitude of the sun or stars at sea, being a large brass ring, the limb of which, or a convenient part thereof, is divided into degrees and minutes, with a moveable index, which turns upon the centre, and turns two sights: at the zenith is a ring to hang it by in time of observation, when you need only turn the index to the sun, that the rays may pass freely through both sights; and the edge of the index cuts the altitude upon the divided limb.

ASTROLOGY, a conjectural and truly absurd science, which teaches to judge of the effects and influences of the stars, and to foretel future events by the situation and different aspects of the heavenly bodies.

ASTRONIUM, in botany, a genus of plants of the pentandria order and diœcia class

The male calyx is five-leaved, and corolla quinquepetalous. The female calyx and corolla are the same as the male; the styli are three, and seed one. There is only one species, which is a native of Jamaica.

ASTRONOMY, the most sublime, useful, and interesting of all the sciences cultivated by mankind, treats of the heavenly bodies and their various phenomena. By some the term is extended to the theory of the universe, with the primary laws of nature; but, properly speaking, astronomy is a mixed mathematical science, by which we become acquainted with the magnitudes, motions, periods, distances, eclipses, &c. of the celestial luminaries.

Astronomy is unquestionably a science of very great antiquity, and, indeed, must have been coeval with the human race, since we cannot suppose that the exhibition of the Divine glory, which is afforded by the heavenly bodies, could fail to attract the attention, and excite the curiosity of those who first beheld it. It is, however, quite uncertain, in what age or country the united observations of many were so far methodized as to raise astronomy to the dignity of a science, and conjectures on the subject would be vain.

Those who have written on the history of astronomy seem agreed that the foundation for a regular system of this science was laid by Hipparchus, who flourished at Alexandria about 162 years before Christ. This philosopher, who was a native of Bithynia, determined the length of the tropical year with unprecedented accuracy; his result not varying more than 4½ minutes from the truth.

In the sixteenth century astronomy began to assume a more rational appearance from the introduction of the system of Copernicus, published at Nuremberg, and afterwards perfected by Kepler and Galileo.

The ancient philosophers, Pythagoras excepted, entertained the idea of the immobility of the earth. This system, called the Ptolemaic system, from Ptolemy, an Egyptian astronomer, places the earth in the centre, and the other planets round about her in the following order: viz. the Moon, Mercury, Venus, the Sun, Mars, Jupiter, and Saturn, beyond which were situated the fixed stars.

This system, which is replete with difficulties, gave way to that which is commonly known by the name of the Copernican system, from the inventor Nicholas Copernicus. This philosopher, with the view of obviating the difficulties of preceding systems, admitted the motion of the earth on her own axis, and also her motion in the ecliptic round the sun. This system met with much opposition; and for maintaining it, Galileo was thrown into the prison of the Inquisition, and purchased his liberty by a recantation of the alleged heresy.

But however accordant with the principles of reason and common sense the system of Copernicus was, it met with a powerful opposition for a time from Tycho Brahe.

From observing that a stone thrown from the top of a lofty tower fell at its base, Tycho supposed that the earth must be without motion; not being aware that the same thing would happen on board a ship sailing at a swift rate, where, if a stone be dropped from the mast head, it will fall at the foot of the mast, provided the motion of the vessel be neither accelerated nor retarded during the time of falling.

This new system, which exceeded the Ptolemaic in confusion and difficulty, died with its projector, and the Copernican system is now universally received.

OF THE APPARENT MOTION OF THE HEAVENLY BODIES.

The circle which terminates our view on all sides, by the apparent meeting of the heavens and earth is called the horizon; which is a great circle of the sphere dividing the concave heavens into two parts, the visible above and the invisible below. The general appearance, therefore, of the starry heavens, is that of a vast concave sphere turning round two fixed points, opposite each other; the one in the northern hemisphere, called the zenith, and that in the southern, called nadir. The fixed points, round which this sphere is supposed to turn, are the poles, and a line drawn from one to another is called the axis of this sphere.

We shall endeavour to illustrate this by means of a diagram. Let HO plate VI. fig. 1, represent the circle of the horizon seen edgeways, when it appears as a straight line; let HPFORQ be the complete sphere of the heavens, of which let HPEO be the visible hemisphere; and HQRO the invisible; then will P be the pole of the former, and R the pole of the latter, and the line PR the axis of the sphere. Draw the line QE through the centre of the sphere C, and it will represent the edge of a great circle equally distant from both poles, and at right angles to the axis; this is called the *equator*, because it divides the heavens into two equal parts. If HO be the horizon, the highest point, or that over our heads, as M, is called the zenith; and the opposite one N, the nadir.

The sun rises in the east, ascends to the highest point in the arch, which he describes, and descends in the west. The highest point to which he ascends is called the mid-day point; through which, and the zenith, if a great circle is drawn, it is called the meridian of the place; and all the stars cross this circle or meridian twice in twenty-four hours, but those which go below the horizon are seen only to cross it once. The three great circles in the heavens are, the horizon, the equator, and the meridian. The first determines the rising and setting of the heavenly bodies; and also their altitude, for which last purpose we must suppose another great circle to pass through the star and the zenith, called a vertical circle, upon which we reckon the number of degrees the star is from the horizon. The quadrant is an instrument used to ascertain this altitude. The three great circles above mentioned form the basis of all observations on the heavenly bodies; and, therefore, it is necessary to determine their relative situations. Had the polar star been exactly at the pole nothing more need be done than to obtain the altitude of this star for that of the pole; but as it is two degrees from the pole, that number must be added to this altitude to find that of the pole.

The elevation of the pole being found it is easy to find that of the equator: thus HMO, or the visible part of the heavens contains 180

deg.; but it is 90 deg. from the pole P to E the equator: now if PE be taken from the semicircle HMO, there remain 90 deg. for the other two arcs; or, the elevation of the pole and equator are together equal to 90 deg.; so that the one being known and subtracted from 90 deg. it will give the other, consequently, the elevation of the pole, at any place, is the complement of the elevation of the equator, and the elevation of the equator is equal to the distance from the pole to the zenith.

The sun does not always rise at the same point; for in the beginning of March he appears to rise more to the north every day, to continue longer above the horizon, and to be higher at mid-day. Thus he continues till towards the end of June, when he retrogrades in the same order till near the end of December, when he begins to move forward as before. This change in the sun's place occasions the difference in the length of the days and nights, and the vicissitudes of the seasons.

The ecliptic is that path or great circle which the sun is supposed to complete in a year. It differs in situation from the equator; for the sun rises above the equator in summer, and not so high in winter. The points of the ecliptic where the sun is when at the greatest distance from the equator are called solstitial points; and the distance between the equator and ecliptic, at those points, is named the obliquity of the ecliptic, which is nearly 23 deg. 30 min.

The equinoctial colure is the great circle which passes at right angles to the equator, through the two points of it intersected by the ecliptic, and called the equinoctial points. The solstitial colure is the other great circle at right angles to the equator, and passes through the poles of the ecliptic.

Lesser circles of the sphere, touching the solstitial points, and at right angles to the axis, as AC, BD are called tropics: that on the north side of the equator is denominated the tropic of Cancer; and that on the south, the tropic of Capricorn. The two polar circles FG, IK are 23 deg. 30 min. distant from the poles.

The zodiac is a broad portion of the heavens, extending about eight degrees on each side of the ecliptic; it is divided into twelve parts, called signs; and each sign into thirty parts or degrees. Circles of celestial longitude are great circles of the sphere, standing at right angles to the plane of the ecliptic, dividing the same into equal parts. Upon the ecliptic is reckoned the longitude of any fixed star, from the point where the ecliptic and equator intersect each other in the vernal equinox, called the first point of Aries, and the arch of any of these circles intercepted between a star and the ecliptic, is the latitude of that star. The equator is divided into degrees, called degrees of right ascension, and from the equator to the poles the degrees of declination are counted on the meridian of the place.

OF THE SOLAR SYSTEM.

If we examine the heavens in a clear night we shall find that the greater of the stars keep the same place with respect to each other, that is, if we observe two stars having a certain apparent distance from one another one night, they will be found to maintain the same distance every succeeding night; these are therefore denominated fixed stars.

But there are others which change their places with regard to the fixed stars, and also to one another. These were formerly five; but Dr. Herschell has discovered a sixth, which he has named Georgium Sidus, though foreign astronomers give it the name of the person who discovered it. Four others have been since discovered by Piazzi, Olbers, and Harding are admitted into the system under the names of Ceres, Pallas, Juno, and Vesta. All these are denominated planets from the word *plano* to err or wander. Besides these there are secondary planets, called satellites or moons, which revolve round certain of the primary ones. Of these our earth has one, Jupiter four, Saturn seven, and the Georgium Sidus six. All the planets move round the sun, from east to west, and in the same direction do the moons revolve round their primaries; excepting those of the Herschell, which seem to move in an opposite direction. The paths in which they move round the sun, are called their orbits, which are ellipses approaching very near to circles. Their revolutions are performed in different periods of time; each of which is the year of the respective planet. See the Table at the end of this article.

The planets are opaque bodies, and shine by reflecting the light which they receive from the sun. Venus and Mercury being nearer to the sun than to our earth are called inferior planets, and the rest, which are without the earth's orbit, are denominated superior planets. We have already said that the planets move round the sun in elliptical orbits; that in which the sun is situated is called the lower focus. If we suppose the plane of the earth's orbit which passes through the centre of the sun, to be extended in every direction as far as the fixed stars, it will describe a great circle, or the ecliptic, with which the situations of the orbits of the other planets are compared.

The planes of the orbits of all the other planets must pass through the centre of the sun; but if extended as far as the fixed stars they form different circles from each other and from the ecliptic; one part of each orbit being on the north, and the other on the south side of the ecliptic. Therefore the orbit of each planet cuts the ecliptic in two opposite points called *the nodes of the planet*. That where the planet passes from the south to the north of the ecliptic is called the ascending node, and the other *the descending node*. The angle which the plane of a planet's orbit makes with the plane of the ecliptic is called the inclination of the planet's orbit.

The two points in a planet's orbit farthest from, and nearest to, the body round which it moves, are called the apsides, the former of which is usually named the aphelion, and the lower, the perihelion; the diamater joining these points is called the line of apsides. When the sun and moon are nearest the earth, they are said to be in perigee, and when farthest from it to be in apogee.

When a planet is between the sun and the earth, or the sun is between it and the earth, then the planet is said to be in conjunction with the sun; and when the earth is between a planet and the sun, that planet is said to be in opposition. When a planet comes between

the earth and the sun, it appears to pass over the disc, or surface of the latter, and this is called the transit of the planet.

When a planet moves from west to east, it is said to have direct motion, or to be in consequentia; and when from east to west, to have retrograde motion, or in antecedentia. The heliocentric place of a planet, is the place which it appears to be in if viewed from the sun; and the place it occupies when viewed from the earth is termed its geocentric place.

The planets do not move with equal velocity in all parts of their orbits, but move faster when nearest to the sun, and slower in the remotest parts; and if a straight line is drawn from the planet to the sun, and this line is supposed to be carried along by the periodical motion of the planet, then the areas described by this line, and the path of the planet, are proportioned to the times of the planet's motion.

The planets perform their periodical revolutions in different times, but the cubes of their mean distances are as the squares of their periodical times.

The sun forms the centre of attraction round which all the planets move. These have also the property of attracting each other, which occasions some irregularity in their motions. This mutual attraction between the planets and the sun keeps them from flying off from their orbits by the centrifugal force, which is generated by their revolving in a curve; and this force again keeps them from falling into the sun, which would be the case, if it were not for the motion impressed upon them. Thus these two powers balance each other, and preserve the order of the system.

This doctrine, which is founded on the demonstrations of Sir Isaac Newton, may be thus illustrated:

If a planet at B (fig. 2. plate VI.) gravitates, or is attracted towards the sun, S, so as to fall from B to *y*, in the time that the projectile force would have carried it from B to X, it will describe the curve BY by the combined action of these two forces, in the same time that the projectile force, singly, would have carried it from B to X, or the gravitating power, singly, have caused it to descend from B to *y*; and these two forces being duly proportioned, the planet obeying them both will move in the circle BYTV. But if, whilst the projectile force would carry the planet from B to *b*, the sun's attraction should bring it down from B to I, the gravitating power would then be too strong for the projectile force, and would cause the planet to describe the curve BC. When the planet comes to C, the gravitating power (which always increases as the square of the distance from the sun, S, diminishes) will be yet stronger for the projectile force, and by conspiring, in some degree, therewith, will accelerate the planet's motion all the way from C to K, causing it to describe the arcs BC, CD, DE, EF, &c. all in equal times. Having its motion thus accelerated, it thereby acquires so much centrifugal force, or tendency to fly off at K, in the line K *k*, as overcomes the sun's attraction; and the centrifugal force being too great to allow the planet to be brought nearer to the sun, or even to move round him in the circle *k l m n*, &c. it goes off, and ascends in the curve KLMN, &c. its motion decreasing as gradually from K to B as it increased from B to K, because the sun's attraction now acts against the planet's projectile motion just as much as it acted with it before. When the planet has got round to B, its projectile force is as much diminished from its mean state as it was augmented at K; and so the sun's attraction being more than sufficient to keep the planet from going off at B, it describes the same orbit over again by virtue of the same forces or powers. A double projectile force will always balance a quadruple power of gravity. Let the planet at B have twice as great an impulse from thence towards X as it had before; that is, the same length of time that it was projected from B to *b*, as in the last example; let it now be projected from B to *c*, and it will require 4 times as much gravity to retain it in its orbit; that is, it must fall as far from B to 4 in the time that the projectile force would carry it from B to C, otherwise it would not describe the curve BD, as is evident from the figure. But in as much time as the planet moves from B to C, in the higher part of its orbit, it moves from I to K, or from K to L, in the lower part thereof; because from the joint action of these two forces, it must always describe equal areas in equal times throughout its annual course. These areas are represented by the triangles BSC, CSD, DSE, ESF, &c. whose contents are equal to one another from the properties of the ellipses.

OF THE SUN.

From the motion of the spots which appear on the face of the sun, it has been found that this great luminary revolves on its axis in twenty-five days. This axis is inclined to the ecliptic, in an angle of about 82° 30′.

The following are Sir Isaac Newton's observations on the sun. 1. That its heat is seven times greater in Mercury, than with us, and that water there would be all carried off in steam. 2. That the quantity of matter in the sun is to that of Jupiter, as 1100 to 1, and that the distance of Jupiter from the sun is in the same ratio to the sun's diameter; consequently the centre of gravity of the sun and Jupiter, is nearly in the superficies of the former. 3. That the quantity of matter in the sun, is to that of Saturn, as 2360 to 1, and the distance of Saturn from the sun is in a ratio little less than that of the sun's semi-diameter, whence the common centre of gravity of Saturn, and the sun is a little within the latter. 4. Therefore the common centre of gravity of all the planets cannot be more than the length of the solar diameter from the centre of the sun. 5. The sun's diameter is equal to 100 diameters of the earth, and the whole body exceeds that of the earth a million of times. 6. If 360 degrees are divided by the quantity of the solar year, it gives 59′ 1″, and the horary motion is 2′ 27′.

OF THE INFERIOR PLANETS.

Mercury being nearest the sun, is seldom visible, and never appears more than a few degrees from the sun's disc. The period of its revolution on its axis is unknown. It is sometimes seen passing over the solar disc, and this is called its transit. Venus is the brightest of the planets, and is termed the morning or

evening star, as it precedes or follows the apparent course of the sun. The time of its rotation on its axis is not known. Venus appears with phases like the moon, and passes sometimes over the sun's disc.

The *elongation* of a planet is its apparent distance from the sun.

An inferior planet is at its greatest elongation when a line drawn from the earth, through the planet, is a tangent to the planet's orbit.

OF THE EARTH.

That our planet is a globular body, is easily proved. Mariners, when they leave land, first begin to lose sight of the lower parts, and so on gradually of the higher: and persons on shore, first see the tops of the masts, before the ships themselves appear. Now, if the earth were a perfect plane, all parts would be seen at once. The earth is not, however, a perfect sphere, but a spheroid, having its equatorial diameter longer than the polar, or the axis, The diameter, at the equator, is 7977 miles. and that at the poles 7940 miles. The earth has two motions; a diurnal, on its own axis in twenty-four hours, and an annual motion round the sun in 365 days 6 hours 56m. 4s. The first motion occasions light and darkness, day and night.

The natural days are not equal; for a natural day is the time wherein the earth performs one revolution round its axis, and such a portion of the second revolution as is equal to the space which the sun has apparently gone that day; but these spaces are unequal, therefore the additional portion of the second revolution will be at times greater or less, consequently the natural days must be unequal. Hence arises the difference between a sun-dial and a time-piece, the former measuring the length of a natural day, and the latter dividing time into equal portions of twelve hours each; the clock will be before the dial when the natural day is more than twenty-four hours, and after it when less.

The *equation* of time is the difference between the mean length of the natural day, and that of a day measured by the sun's apparent motion, or between *mean* and *apparent* time. The hour by apparent time being known, to find what is the true time, add the equation to apparent time, if the day, by the clock, is shorter than by the dial; and subtract it when longer.

The causes of the difference between mean and apparent time, are, 1. The obliquity of the ecliptic with regard to the equator. 2. The unequal motion of the earth in an elliptical orbit.

The heavenly bodies appear higher than they really are, owing to the refraction of the rays of light by our atmosphere; so that to bring the apparent to the true altitudes, the quantity of refraction must be subtracted according to a table which may be found in all books of elemental astronomy.

The twilight is also owing to this refraction of the rays, which, being bent by the atmosphere, visit the earth before the sun actually rises, and keep him in view after he is set.

OF THE SEASONS.

These are occasioned by the annual motion of the earth. The better to understand this, it must be considered that the axis of the earth is inclined to the plane of its orbit, about 23d 30m. and it always keeps parallel to itself, or is directed constantly to the same point of the heavens.

Let fig 4, Plate VI. represent the earth in different parts of its elliptic orbit. In the spring, the circle which separates the light from the dark side of the globe called the terminator, passes through the poles *n*, *s*, as appears in the position A. The earth then, in its diurnal rotation about its axis, has every part of its surface as long in light as in shade; therefore the days are equal to the nights all over the world; the sun being at that time vertical to the equatorial parts of the earth. As the earth proceeds in its orbit, and comes into the position B, the sun becomes vertical to those parts of the earth under the tropic, and the inhabitants of the northern hemisphere will enjoy summer on account of the solar rays falling more perpendicularly upon them; they will also have their days longer than their nights, in proportion as they are more distant from the equator; and those within the polar circle, as will be perceived by the figure, will have constant day-light. At the same time the inhabitants of the southern hemisphere have winter, their days being shorter than their nights, in proportion as they are farther from the equator; and the inhabitants of the polar regions will have constant night. The earth then continues its course to the position C, when the terminator again passes through the poles, and the days and nights are equal. After this the earth advances to the position D, at which time the inhabitants of the northern hemisphere have winter, and their days are shorter than their nights. The positions B and D are the solstitial points, and A and C the equinoctial points; they are not equidistant from each other, because the sun is not in the centre, but in the focus of the ellipsis. In summer, when the earth is at B, the sun is farther from it than in winter, when the earth is at D; and, in fact, the diameter of the sun appears longer in the winter than in summer. The difference of heat is not owing to the sun's being nearer to us, or more remote, but to the degree of obliquity with which its rays strike any part of the earth

OF THE MOON.

The moon is a spherical body, and revolves round the earth in an elliptical orbit, and is carried with it round the sun. The moon always has the same side towards us, and its periodical time is equal to that of its revolution in its orbit round the earth. Though the year to the earth and moon is of the same length, the number of their days is different: the former having 365 natural days, and the latter only about 12, every day and night in the moon being equal to 29 days 30 hours on the earth. The face of the moon, as seen through a telescope, appears diversified with mountains and valleys. The height of the lunar mountains has been accurately ascertained by Dr. Herschel, who concludes, that with few exceptions they do not exceed half a mile. The same astronomer also discovered several volcanoes in the moon.

The phases of the moon, as they appear at eight different points of her orbit are represented in plate VII, where S represents the sun.

T the earth, and ABCD, &c. the moon's orbit. When the moon is at A, in conjunction with the sun S, her dark side being entirely towards the earth, she will be invisible, as at *a*, and is then called the new moon. When she comes to her first octant at B, a quarter of her enlightened hemisphere will be turned towards the earth, and she will then appear horned, as at *b*. When she has run through the quarter of her orbit, and arrived at C, she shews us the half of her enlightened hemisphere as at *c*, when it is said she is one half full. At D she is in her second octant, and, by shewing us more of her enlightened hemisphere than at C, she appears gibbous as at *d*. At her opposition at E, her whole enlightened side is turned towards the earth, when she appears round, as at *e*, and she [illegible] said to be full; having increased all the way round from A to E. On the other side she decreases again all the way from E to A; thus, in her third octant at F, part of her dark side being turned towards the earth, she again appears gibbous, as at *f*. At G she appears still farther decreased, shewing again exactly one half of her illuminated side, as at *g*. But when she comes to her fourth octant at H, she presents only a quarter of her enlightened hemisphere, and again appears horned, as at *h*. And at A, having now completed her course, she again disappears, and becomes a new moon again, as at first.

OF THE SUPERIOR PLANETS.

Mars is of a reddish colour, and from some spots on its surface, it appears that the inclination of the axis of this planet to the ecliptic is 59d. 42m. the node of the axis is in 17d. 47m. of Pisces, the obliquity of the ecliptic thereon, 28d. 42m.

The figure of Mars is that of an oblique spheroid, the equatorial diameter of which is to the polar, as 16 to 15.

Ceres Ferdinandea, is the name of a small planet situated next beyond Mars, and was discovered on the first day of the present century, by Piazzi, an Italian astronomer.

Pallas is another small planet, discovered by Dr. Olbers, of Bremen, in 1802. Juno is another small planet, discovered by M. Harding, in 1804, and Vesta, another, was first seen by Dr. Olbers, March 29th, 1807.

These four planets Dr. Herschel calls asteroids. Jupiter is the brightest of the planets, except Venus. Several belts are observed across its surface, and parallel to its equator. These are supposed to be large ranges of clouds in the atmosphere of the planet, as they are sometimes of different breadths. Large spots have also been seen in these belts. Jupiter has four moons of different magnitudes, which are occasionally eclipsed by the shadow of the planet falling on them. These are of considerable use in astronomy and navigation, for the purpose of determining the longitudes of places.

Saturn is seldom seen by the naked eye. Viewed through a telescope, it presents a remarkable appearance, being surrounded by a luminous ring. This ring, which casts a strong shadow upon the planet, appears to be divided into two by a line in the middle of its breadth. Besides, the ring Saturn has seven moons of different sizes; and on its body it has belts like those of Jupiter.

The Georgium Sidus, or Herschel planet, with its six satellites, was the discovery of Dr. Herschel, in 1781. It cannot be seen but by a telescope.

It is evident, from the principles of optics, that the determination of the real diameters of the celestial bodies, depends on the knowledge of their apparent diameters, and their actual distances from the earth.

The sun's vertical, or perpendicular diameter, may be had by two observers taking, at the same time, one the height of the upper edge of the disc, the other the lower. This will be best done when the sun is at the meridian. The height of each edge must be corrected by allowing for parallax and refraction; and the apparent diameter will be equal to the difference of the corrected altitudes of the upper and lower edge. Another method is, to observe by a good clock, the time in which the sun's disc passes over the plane of the meridian, or some other hour circle. At, or near one of the equinoxes, when the sun's apparent diurnal motion is in the equator, or a parallel near it, say, at the time between the sun's leaving the meridian and return to it : 360d. : : the time in which he passes over the meridian : his apparent semi-diameter. At any other time of the year, when the sun is in a parallel at a greater distance from the equator, say, as radius : the sine of the sun's declination : : the time in which the sun passes the meridian, converted into motion at the rate of four minutes in time to 1d. : the arc of the great circle which measures the sun's apparent horizontal diameter.

OF THE SATELLITES.

As the satellites uniformly describe orbits nearly with their respective primaries, at the centre or focus, they are most probably moved by a similar force to that which moves the planets round the sun, consequently they must describe the areas of their orbits proportional to the times: and their mean distances from the centres of the primaries must be the cube-roots of the squares of the times of their revolutions.

The time of a synodic revolution of a satellite may be thus found: observe when the primary planet is in opposition to the passage of the satellite over its body, and mark the time when it is half-way between the two opposite edges of the planet's disc, for then it will be nearly in conjunction with the centre of the planet, and also in conjunction with the sun. After some time, observe when the primary is in opposition, and the satellite in conjunction with its centre, and divide the intervening period between the two observations, by the number of conjunctions of the sun, in that space, which will give the time of a synodic revolution. Another method is by means of the eclipses of the satellites; observe when the satellite enters the shadow of its primary, called its immersion, or when it comes out of the shadow, called its emersion; and after some time repeat the same observation when an eclipse again occurs, and from the interval of these times, and the number of eclipses in that interval, the mean time of a synodic revolution will be had by division.

The distance of a satellite from its primary, may be found by means of its greatest elonga-

tion, as seen from the earth. Another method is, by measuring with a micrometer at the time of the satellite's elongation, its distance from the centre of the planet, also the semi-diameter of the planet, the distance being in the same terms as the semi-diameter. Or when the periodic times of all the satellites are known, and the mean distance of one of them; the mean distances of the others may be found from the proportion between the squares of the periodic times and the cubes of the distances

OF COMETS.

These are opaque bodies, with long tails, or trains, on the side remote from the sun, round which they revolve in eccentric ellipses; Sir Isaac Newton computed the heat of the comet which appeared in 1680 to be, when nearest to the sun, 2000 times hotter than red hot iron. In their motions round the sun, the comets are subject to the same irregularities as the planets, only their variations are more considerable. When they are near the sun, their motion is very rapid, and in the remoter parts of their orbits extremely slow. Dr. Halley has calculated tables for determining the orbits of the comets, which, in general, have been found very exact. The number of comets belonging to our system is unknown; but, from the accounts of the ancients, and the observations of the moderns, it appears that about 450 had been seen previous to 1771, and since that time, several others have occasionally been discovered.

OF THE FIXED STARS.

Th[illegible] called, on account of their not changing their places as the planets do. They appear of various magnitudes; but, for convenience, astronomers class them into six or seven divisions. To the naked eye they seem to be innumerable, but this is a deception occasioned, probably, by the refraction of our atmosphere.

The ancients divided the stars into several constellations, or systems; to distinguish which, they gave them names according to their fancies To these have been added several others by modern observers.

Those stars which are not included in any constellation, are denominated unformed. Besides the names of the constellations, the ancient Greeks gave particular appellations to some single stars, or small groupes of them; thus, those in the neck of the Bull were called Pleiades; five in the Bull's face, Hyades; a bright star in the breast of Leo, the Lion's Heart; and one between the knees of Bootes. Arcturus.

Greek letters have been added by Bayera to stars in the several constellations of his catalogue, (α being affixed to the largest star) by means of which, any star may be easily found.

Twelve of the constellations lie upon the ecliptic, including a space about 16 degrees in breadth, called the zodiac, within which all the planets move. The constellations as far as the triangle, with Coma Berenices, are northern, those after Pisces, southern. The distances of the fixed stars from us cannot be ascertained, therefore they must shine by their own light as our sun does, whence it is inferred, that they are suns to systems similar to ours. Some of the larger stars have not the same situations observed by ancient astronomers; and new stars have appeared, while others, formerly described, are no longer seen. Some stars have a periodical increase and decrease: and many of the fixed stars, upon examination by the telescope, are found to consist of two.

The *via lactea* or milky way, is a broad belt or zone, of a whitish appearance, which consists of an infinite number of small stars not to be discerned but by a very powerful telescope. Dr. Herschell is of opinion, that the universe is full of these nebulæ or systems of stars, and that the milky way is the nebula in which our system is situated.

OF ECLIPSES.

When any of the heavenly bodies is obscured, or darkened by the shadow of another falling upon it, or by the interposition of any body, it said to be eclipsed. Eclipses were formerly viewed as ominous, but the improvements of science have clearly proved that they have no connection with future events; but that they depend entirely upon regular and invariable causes, and may be calculated and foretold with the greatest certainty. As the earth is an opaque body, enlightened only by the sun, it will cast a shadow towards that side which is farthest from the sun. As the sun is much larger than the earth, the shadow of the latter must be conical, or end in a point. See plate VI. fig. 5.

On the sides of this conical shadow, there is a diverging shadow, the density of which decreases in proportion as it recedes from the sides of the former conical shadow: this is called the penumbra. As the moon revolves round the earth sufficiently near to pass through the shadow of the earth, an eclipse must always take place when these three are all in one straight line. An eclipse of the moon can never happen but at the time of full moon; but on account of the inclination of the moon's orbit to that of the earth, an eclipse cannot take place every full moon. When the moon passes entirely through the earth's shadow, the eclipse is total; but when only part of it passes through the shadow, the eclipse is partial. The quantity of the moon's disc which is eclipsed, (and the same thing is to be understood of that of the sun in a solar eclipse,) is expressed by twelve parts, called digits, that is, the disc is supposed to be divided by twelve parallel lines; then if half the disc is eclipsed, the quantity of the eclipse is said to be six digits. When the diameter of the shadow, through which the moon must pass, is greater than the diameter of the moon, the quantity of the eclipse is said to be more than twelve digits; thus, the diameter of the moon is to that of the shadow as four to five, then the eclipse is said to be fifteen digits. The duration of a lunar eclipse is various, it sometimes lasts two or three hours. The eclipses of the sun are owing to a different cause than those of the moon. They are occasioned by the moon's coming directly between us and the sun, and therefore obstructing our view of it. When the moon happens to be in conjunction with the sun, or between the sun and the earth, *viz.* at the time of the new moons, the shadow of the moon falls upon the surface of the earth; hence, properly speaking, such

eclipses should be called *eclipses of the earth.* But the whole disc of the earth cannot be involved in the shadow of the moon, because the moon is much smaller than the earth, and the shadow of the moon is conical. Thus, in plate VI. fig. 6, the rays of the sun, S, being intercepted by the moon, L, form the conical shadow CDG, which, falling upon the surface of the earth, entirely deprives that portion of it, upon which it falls, of the sun's light, and of course the inhabitants of that part of the earth will have a total eclipse of the sun. Beyond the dense conical shadow CDG there is a diverging half shadow, or penumbra CDEF, which is occasioned by the moon's intercepting only a part of the sun's rays from those places which fall within this penumbral cone, and are out of the dense shadow. Thus from the part of the earth Z, the portion YYB of the sun only can be seen; consequently the inhabitants of that part will have a partial eclipse.

As the moon is not always at the same distance from the earth, it sometimes happens that the conical dense shadow does not reach the earth, as in fig. 7, and only the penumbral shadow falls upon it, the eclipse consequently is partial to every part of the earth. Those who are at the centre of the penumbra will lose sight of the centre of the sun, by the interposition of the moon's body, which subtending a smaller angle than the sun, will not entirely [illegible] 'll be a ring of light all around. The eclipse is then said to be annular.

OF THE TIDES.

The ocean covers more than half the globe; and this large body of water is in continual motion, ebbing and flowing alternately; that is, if the tide is now at high water mark, it will presently subside and flow back for about six hours, when it will be at low water mark: the time of high water, however, is not always the same, but is about three quarters of an hour later every day, for near thirty days, when it begins as before.

For example: suppose at a certain place, it is high water at three o'clock in the afternoon on the day of new moon; the next day it will be high water at three quarters of an hour after three, the day following at half-past four, and so on till the next new moon, when it will be again high water at three. This answers to the motion of the moon; for she rises every day about three quarters of an hour later than the preceding one; and thus completes her revolution round the earth in about thirty days.

According to the Newtonian principle of attraction, these phænomena are thus explained. The waters at Z on the side of the earth, *next the moon M, (figure 3.) are more attracted than the central parts O by the moon,* and these again more than the waters on the opposite side at N; therefore the distance between the earth's centre and the waters on its surface under and opposite the moon will be increased. To explain this more particularly, though the earth's diameter bears a considerable proportion to its distance from the moon, yet this diameter is nothing when compared to the earth's distance from the sun, consequently the difference of the sun's attraction on the sides of the earth opposite to him, will be far less than the difference of the moon's attraction on the sides opposite to her; therefore the moon must raise the tides higher than they could be by the sun. Sir Isaac Newton has determined that the influence of the sun in this case is three times less than that of the moon. The tides, then, are properly the joint production of the sun and moon; or, in fact, there are two tides, a solar and a lunar, whose effects are joint or opposite according to the situation of the bodies by which they are effected. When the sun and moon act together, as at new and full moon, the flux and reflux become considerable; and are called spring tides. But when one tends to elevate the waters, and the other to depress them, as at the moon's first and third quarters, then the flux and reflux will be diminished; these are called neap tides.

The sun being farther from our hemisphere in March and September, than in February and October, is the cause why the greatest tides happen a little before the vernal, and a little after the autumnal equinox.

When the moon is in the equator, the tides are equally high in both parts of the lunar day, which is 24 hours 50 minutes; but as she declines towards either pole the tides are alternately higher or lower in northern or southern latitudes. The tides are so retarded in their passage through channels, and so affected by capes, and head-lands, as to happen variously at different places. The tide raised in the German Ocean, when the moon is three hours past the meridian, takes three hours to arrive at London Bridge. Lakes have no tides because every part is attracted alike. The Mediterranean and Baltic seas have but small elevations, on account of the narrowness of the inlets by which they communicate with the ocean.

For more ample information on the subject of astronomy, the reader is referred to the works of Ferguson, Gregory, Bonnycastle, Vince, Squire, and others.

The following Tabular view of the Solar System is taken from Ferguson's Astronomy by Dr. Brewster. Second edition.

TABULAR VIEW OF THE SOLAR SYSTEM.

Names of the Planets.	Mean diameters in English miles.	Mean diameters from the sun, in round numbers of miles.	The correct mean distances, that of the earth being 100000.	Mean apparent diameters as seen from the earth.	Mean diameters as seen from the sun.	Densities, that of water being 1.	Proportional quantities of matter.	Diurnal rotations round their own axis.	Inclination of axis to orbits.	Inclination of orbits to the ecliptic in 1780.
The Sun	883246			32′ 1″.5		$1\frac{3}{13}$	333928	25ᵈ 14ʰ 8′ 0″	82° 44′ 0″	
Mercury	3224	37,000,000	38710	10	16″	$9\frac{1}{6}$	0.1654	14 24 5 28	- - - -	7° 0′ 0″
Venus	7687	68,000,000	72333	58	30	$5\frac{11}{15}$	0.8899	0 23 21 8	- - - -	3 23 35
The Earth	7911.73	95,000,000	100000		17 .2		1	1 0 0 0	66 32 0	0 0 0
The Moon	2180	95,000,000	100000	31 8	4 .6	$4\frac{1}{2}$	0.025	29 17 44 3	88 17 0	5 9 3 at a mean.
Mars	4189	144,000,000	152369	27	10	$3\frac{2}{7}$	0.0875	0 24 39 22	59 22 0	1 51 0.
Ceres.	163 1024	263,000,000	276500	1 6 .4	- -	2	- -	- - - - - -	- - - -	10 37 0 in 1804.
Palla	80 2099	265,000,000	279100	0 .5 6 .5	- -	2	- -	- - - - -	- - - -	34 50 40 in 1804.
Juno	1425	252,000,000	265700	3	- -	- -	- -	27 hours probably.	- - - -	21 0 13 4 in 1804.
Vesta	238	225,000,000	237300	0 5	- -	- -	- -	- - - - - -	- - - -	7 8 46 in 1809.
Jupiter	89170	490,000,000	520279	39	37	$1\frac{1}{24}$	312.1	0 9 55 37	90 nearly.	1 18 50 in 1780.
Saturn	79042	900,000,000	954072	18	16	$0\frac{13}{32}$	97.76	0 10 16 2	60 probably	2 20 50 in 1780.
Georgium Sidus	35112	1,800,000,000	1908352	3 54	4	$0\frac{22}{100}$	16.84	- - - - - -	- - - -	0 46 20 in 1780.

ASTROSCOPE, an instrument composed of two cones, having the constellations delineated on their surfaces, whereby the stars may be easily known.

ASYMMETRY, in a general sense, the want of proportion between the parts of any thing, being the contrary of symmetry.

In mathematics it is used for what is more commonly called incommensurability, or the relation of two quantities which have no common measure, as between one and the square root of two, or as $1 : \sqrt{2}$, or the side and diagonal of a square.

ASYMPTOTE, in geometry, a line which approaches nearer to another continually, and never meets it. Properly, the term is appropriated to right lines, which continue to approach nearer to curve.

ASYNDETON, in grammar, a figure which omits the conjunctions in a sentence, as in that verse of Virgil:

Ferte citi flammas, date vela, impellite remos.

ATCHIEVEMENT, vulgarly *hatchment*, in heraldry, the arms of a person or family with all the ornaments appended to it.

ATHAMANTA, in botany, a genus of the pentandria digynia class and order, in the natural method ranking under the forty-fifth order, umbellatæ. There are nine species, the principal of which is, the athamanta cretensis, or daucus creticus, which grows wild in the Levant. It rises about two feet in height, and the branches bear white flowers.

ATHANASIA, *goldilocks*, a genus of the polygamia æqualis order, and syngenesia class of plants, ranking in the natural method under the forty-ninth order, compositæ discoides. There are twenty species, but none remarkable.

ATHENÆA, a genus of plants, of the class and order octandria monogynia. There is only one species, which is an aromatic shrub that grows in Africa.

ATHENÆUM, in antiquity, a public place wherein the professors of the liberal arts held their assemblies, the rhetoricians declaimed, and the poets rehearsed their performances.

ATHERINA, in ichthyology, a genus of abdominal fishes, distinguished by having the upper jaw rather flat, six rays in the gill membrane, and a silvery stripe on each side of the body. There are five species of this genus: the most remarkable are:

1. Atherina hepsetus, with about 12 rays in the fin next the anus. It is found in the Mediterranean. It is also very common in the sea near Southampton, where it is called a smelt.

2. Atherina menidea, has 24 rays in the fin next the anus. This is a very pellucid fish, with many black points interspersed; it has many teeth in the lips, but none in the tongue or jaws. It is found in the fresh waters of Carolina.

ATHWART, in naval affairs, across the line of the ship's course, as "We discovered a fleet standing athwart us," i. e. steering across our way.

ATHWART *hawse*, the situation of a ship when she is driven, by an accident, across the stem of another, whether they bear against, or at a small distance from each other: the transverse position being principally understood.

ATLAS, in matters of literature, denotes a book of universal geography, containing maps of all the known parts of the world.

ATLAS, in commerce, a sort of silk or satin manufactured in the East Indies, in which gold and silk are so wrought together, as no workman in Europe can imitate. In China they weave long slips of gilt paper into their silks. The same slips of paper are twisted about silk threads so artificially, as to look finer than gold thread, though of no great value.

ATMOSPHERE. See PNEUMATICS.

ATOM, from the Greek ατομος, compounded of a privative, and τεμνω, I cut. The word is used to signify such a small particle of matter as cannot be physically divided. Such particles are said to be the first rudiments, or component parts of all bodies. See DIVISIBILITY.

ATOMICAL *philosophy*, the philosophy of Epicurus, which ascribes to atoms the properties of gravity and motion. On this ground that philosopher accounted for the origin and formation of things.

ATOMIC *theory*, a species of philosophy recently introduced into chemistry, the nature of which may be understood from the following brief outline.

The progress which chemists have made in the investigation of the component parts of bodies, has led to the adoption of this axiom, viz. that, "*Chemical union consists in the combination of the atoms of bodies with each other.*" Thus when two bodies unite chemically, so as to form a third body, the two substances united are dispersed every where through the new compound.

Water, for example, is composed of oxygen and hydrogen. Now, how minute soever the portion of water may be which we examine, it will be found to contain both oxygen and hydrogen. Saltpetre is a compound of nitric acid and potash. If we examine the salt whether we take an ounce or the hundredth part of a grain, we shall always find it to be a compound of nitric acid and potash. If any portion of it were to want one of these constituents, it would no longer be saltpetre; it would be potash, or nitric acid, according to the constituent which is not present. Limestone is a compound of carbonic acid and lime. Now we may reduce it to an impalpable powder; but if we take one of the grains of this powder, however small, and throw it into nitric acid, we shall perceive an effervescence, indicating the presence of carbonic acid, and it will dissolve, indicating that lime was also one of its constituents. Mechanical trituration, however carefully made, is quite incapable of separating from each other, substances which are chemically combined. Thus all chemical compounds contain the same constant proportion of constituents with the most rigid accuracy, no variation whatever taking place. See the article in the Supplement to the Encyclopædia Britannica.

ATRACTYLIS, a genus of the syngenesia polygamia class of plants, of which there are eight species. 1. Atractylis cancellata, or small cnicus is an annual plant, rising about eight or nine inches high, with a slender stem; at the top of the branches are two or three slender stalks, each terminated by a head of purple flowers. 2. Atractylis gummifera, or prickly gum bearing cnicus, called also carline thistle. It is a perennial plant; and has many white

and yellow florets in a prickly empalement. 3. Atractyilis humilis, or purple prickly cnicus, grows to the height of a foot, with purple flowers. They are all natives of the southern parts of Europe.

ATRETI, in medicine, a term applied to persons who have the anus, vagina, urethra, &c. imperforate, whether naturally or occasioned by disease.

ATRIPLEX, *orach*, in botany, a genus of the polygamia monœcia class of plants, without any flower petals; the cup of the female flower is composed of two leaves, inclosing a single and compressed seed; whereas that of the hermaphrodite flower is composed of five leaves, and incloses a single roundish, and depressed seed. There are fourteen species.

ATROPA, DEADLY NIGHT-SHADE; a genus of the monogynia order, and pentandria class of plants; and in the natural method ranking under the 25th order, luridæ. The corolla is campanulated; the stamina are distant; the berry is globular, and consists of two cells. There are eight species; of which the following are the most remarkable. 1. Atropa belladonna, which has a perennial root, with stalks and leaves of a purplish colour. The flowers are large, bell-shaped, and of a dusky colour. When the flower is past, the germen turns to a round berry, which is first green, but, when ripe, turns black, and contains a purple juice, and is full of small seeds. This species is remarkable for its poisonous qualities. A glass of warm vinegar will counteract its bad effects. 2. Atropa frutescens is a native of Spain, and rises to the height of 6 or 8 feet. The flowers are of a yellow colour, but are not succeeded by berries. 3. Atropa herbacea is a native of Campeachy, and grows to the height of two feet. The flowers are white. 4. Atropa mandragora, or the mandrake, which has been distinguished into the male and female. It is a native of the warm parts of Europe.

ATROPHY, in medicine, a disease wherein the body or some of its parts do not receive the necessary nutriment, but waste and decay incessantly.

ATTACHMENT, in law, is the taking or apprehending a person by a writ or precept: it is distinguished from arrest by its lying sometimes on goods only, and sometimes on goods and persons.

ATTAINDER, in law, is when a man has committed felony or treason, and sentence is passed upon him for the same. The children of a person attainted of treason, are, thereby, rendered incapable of being heirs to him, or to any other ancestor; and if he were noble before, his posterity are degraded and made base: nor can this corruption of blood be salved but by an act of parliament, unless the sentence be reversed by a writ of error.

Attainder, *bill of*, a bill brought into parliament for attainting, condemning, and executing a person for high-treason.

ATTIC, in architecture, a sort of building wherein the roof or covering is not to be seen; thus named, because the buildings at Athens were generally of this form.

ATTITUDE, in painting and sculpture, the gesture of a figure, or statue; or it is such a disposition of their parts, as serves to express the action and sentiments of the person represented.

ATTORNEY *General*, is a great officer under the king, created by letters patent, whose office it is to exhibit informations, and prosecute for the crown in criminal causes, and to file the bills in the exchequer, for any thing concerning the king in inheritance or profits. To him come warrants for making of grants, pardons, &c.

ATTORNIES *at law*, are such persons as take upon them the business of other men, by whom they are retained. No man can lawfully act in this capacity unless he has been bound, by contract in writing, for the space of five years to a regular attorney, and has, at the expiration of that period, been examined, sworn, admitted, and enrolled.

ATTRACTION, a general term used to denote the power or principle by which bodies mutually tend towards each other, without investigating the cause or action by which such effect is prodced.

There are commonly reckoned five kinds of attraction, viz. the attraction of *cohesion*, of *gravitation*, of *electricity*, of *magnetism*, and *chemical attraction*.

The attraction of *cohesion* is that by which the minute particles of matter are held together; and is only exerted at very small distances. The strength of this attraction being so different in different substances, is supposed by some to be the cause of their relative hardness or softness. This species of attraction may be observed in almost all the common operations of nature, and may be exemplified by many easily performed experiments.

Two leaden balls, having each a smooth surface, if strongly compressed together, will cohere almost as strongly as if united by fusion; and even two plates of glass, if the surfaces are even and dry, will require some force to separate them. By the same law of nature the particles of even fluid bodies, in which the attraction is necessarily weaker than in solid substances, indicate a disposition to unite. To this also may be referred what is called capillary attraction. The attraction of *gravitation* is one of the most universal principles in nature. It is that force by which distant bodies tend towards each other. By gravity, a stone dropped from a height falls to the earth; by it the heavenly bodies are kept in their orbits; and hereby all terrestrial bodies tend towards the centre of the earth. By it, the planets tend towards the sun, and towards each other, as well as the sun does to them. From this attraction arises all the motion, and consequently all the changes that take place, in the grander portions of the universe. By this heavy bodies descend, and light ones ascend; by this, projectiles are directed, and rains fall; rivers glide, the ocean swells, and the air presses upon different bodies.

The attraction of *electricity* is analogous to that of gravity in the property of acting upon bodies at a certain distance; but it differs from it in its operation being confined to a particular state of those bodies, that is, when excited by friction.

The attraction of *magnetism* only differs from that of gravity in its operations being limited to particular substances. The magnet is an ore of iron, and its property of attracting certain portions of that metal at moderate distances is well known.

The attraction of *combination*, or chemical elective attraction, is, in many respects, like that of cohesion; for it seems to depend on the minute particles of bodies being brought nearly into contact with each other. Chemical attraction may be, in fact, only the attraction of cohesion acting in an unresisting medium, since its distinguishing characteristic is, the disposition which bodies, in solution, indicate to unite with some substances, in preference to others.

ATTRIBUTES, in logic, are the predicates of any subject, or what may be affirmed or denied of any thing.

Attributes, in painting and sculpture, are symbols added to several figures, to intimate their particular office and character. Thus the eagle is an attribute of Jupiter; a peacock, of Juno; a caduce, of Mercury; a club, of Hercules; and a palm, of Victory.

ATTRITION, the rubbing or striking of bodies one against another, so as to throw off some of their superficial particles.

The grinding or polishing of bodies is performed by attrition, the effects of which are heat, light, fire, and electricity.

AVALANCHES, a name given in Switzerland and Savoy, to those prodigious masses of snow, which are precipitated with a noise like thunder from the mountains, destroying every thing in their course. They sometimes overwhelm whole villages.

AVAST, in the sea language a term requiring to stop, to hold, or to stay.

AUBLETIA, in botany, so named from M. Aublet, the author of the history of plants in Guiana a genus of the polyandria monogynia class and order.

AVENA, oats, a genus of the digynia order, belonging to the triandria class of plants, and in the natural method ranking under the 4th order, gramina. The calyx has a double valve, and the awn on the back is contorted. There are 25 species, six of which are natives of England. The original native place of the avena sativa, or common oats, cultivated in our fields, is almost totally unknown.

AVERAGE, in commerce, signifies the accidents and misfortunes which happen to ships and their cargoes, from the time of their loading and sailing to their return and unloading; and is divided into three kinds: viz. 1. The simple or particular average, which consists in the extraordinary expenses incurred for the ship alone, or for the merchandizes alone, such as the loss of cables, anchors, &c. 2. The large and common average, or those expenses incurred for the security of the merchandizes and vessels, and consequently borne by the ship and cargo. 3. The small averages, or the expenses of piloting a ship, a third of which must be charged to the ship, and two thirds to the cargo.

AVERRHOA, a genus of the decandria order, and pentagynia class of plants, in the natural method, ranking under the 14th order, gruinales. There are two species: the principal is the averrhoa carambola, called in Bengal the camrue, or camrenga, grows to the height of 14 feet, and its leaves, on being touched, move perceptibly. After sunset the leaves go to sleep, first moving down so as to touch each other by their under sides.

AUGITE, a mineral of the chrysolite family, found in basalt, sometimes in grains, but most commonly in crystals, mostly small and complete. Colour, blackish green, sometimes passing into leek green, and rarely to liver brown. Specific gravity 3.22 to 3.47. Before the blow-pipe it is, with difficulty, converted into a black enamel.

AVES, *birds*, among naturalists, the second class of animals, a race of creatures sufficiently distinguished from others in having the body covered with feathers, two feet, and two wings formed for flight. Birds have the mandible protracted and naked; and are destitute of external ears, lips, teeth, scrotum, womb, urinary vessel, or bladder, epiglottis, corpus callosum, or its fornix, and diaphragm. In the Linnæan system, birds are divided into six orders, viz. accipitres, or falcon kind; picæ, or pies; anseres, or geese and duck kind; grallæ, cranes, or waders; gallinæ, the poultry kind; and passeres, sparrows, or small birds.

AVIARY, a place set apart for feeding and propagating birds. It should be so large, as to give the birds some freedom of flight; and turfed, to avoid the appearance of foulness on the floor.

AVICENNA, a genus of plants, of the tetrandria monogynia class, the flower of which consists of a single petal; the fruit is a coriaceous capsule of one cell, containing one seed of an elliptic figure. There are three species, all natives of the West Indies.

AVOIRDUPOISE *weight*, a sort of weight used in England, of which the pound consists of sixteen ounces. The proportion of a pound avoirdupoise to a pound troy is as 17 to 14.

AURICLE, in anatomy, that part of the ear which is prominent from the head, called by many authors *auris externa*.

AURICLES *of the heart*. These are a kind of appendages of the heart at its base, and are distinguished by the names of the right and left. The right auricle is much larger than the left, and this is placed in the hinder, that in the anterior part. They are intended as diverticula for the blood, during the systole. Their substance is muscular, being composed of strong fibres, and their motion is not synchronous, but achronous with that of the heart. See Anatomy.

AURICULAR *medicines*, such as are used in the cure of distempers in the ear.

AURIGA, the *Waggoner*, in astronomy, a constellation of the northern hemisphere, consisting of 23 stars, according to Tycho; 40 according to Hevelius; and 66 in the Britannic Catalogue. This constellation is represented by the figure of an old man, in a posture somewhat like sitting, with a goat and her kids in his left hand, and a bridle in his right.

AURORA *borealis*, or Aurora *septentrionalis*, in physiology, the northern dawn or light, sometimes called streamers, is an extraordinary meteor, or luminous appearance, shewing itself in the night-time in the northern part of the heavens: and most usually in frosty weather. It is usually of a reddish colour, inclining to yellow, and sends out frequent coruscations of pale light, which seem to rise from the horizon in a pyramidal undulating form, and shoot with great velocity up to the zenith. The aurora borealis appears frequently in form of an arch, chiefly in the spring and autumn, after a dry year. The arch is partly bright, partly dark, but generally transparent

and the matter of which it consists is also found to have no effect on the rays of light which pass through it.

This kind of meteor, which is more uncommon as we approach towards the equator, is almost constant during the long winter, and appears with the greatest lustre in the polar regions. In the Shetland Isles, the "merry dancers," as the northern lights are there called, are the constant attendants of clear evenings, and afford great relief amidst the gloom of the long winter nights.

Various theories have been offered at different times for explaining the cause of this phenomenon, but the most correct of these appears to be that which refers it to electricity, which see.

AURUM. See GOLD.

AURUM MUSIVUM, or MOSAICUM, is a combination of tin and sulphur, which is thus made: Twelve ounces of tin are first melted; to this three ounces of mercury are then added: this amalgam is then triturated with seven ounces of sulphur, and three of muriate of ammonia. The powder is then put into a matrass bedded in sand, and kept for several hours in a gentle heat, after which, the heat must be increased. If the heat have been properly regulated, the golden-coloured scaly porous mass, called aurum musivum, will be found at the bottom of the vessel. This substance is used as a pigment for giving a golden colour to small statues or plaster figures. It is sometimes used also with melted glass to imitate lapis lazuli.

AUTOMATUM, or AUTOMATON, an instrument, or rather machine; which, by means of springs, weights, &c. seems to move itself as a watch, clock, &c. Such also were Archytus's flying dove, Regiomontanus's wooden-eagle, &c.

AUTUMN, the third season of the year, which begins on the day when the sun enters Libra. Autumnal signs in astronomy are Libra, Scorpio, and Sagittarius. Autumnal point is that part of the equinox from which the sun begins to descend towards the south pole.

AWL, or AUL, among shoemakers, an instrument wherewith holes are bored through the leather, to faciliate the stitching or sewing the same. The blade of the awl is usually a little flat and bended, and the point ground to an acute angle.

AUXILIARY *verbs*, in grammar, are such as help to form or conjugate others; that is, are prefixed to them, to form or denote the moods or tenses thereof: as *to have* and *to be*.

In the English language the auxiliary verb *am* supplies the want of passive verbs.

AXILLA, in anatomy, the arm-pit, or the cavity under the upper part of the arm. *Axilla*, in botany, is the space between the stems and leaves of plants.

AXIOM, in philosophy, is such a plain, self-evident, and received notion, that it cannot be made more plain and evident by demonstration, because it is itself better known than any thing that can be brought to prove it.

AXIS, in geometry, the straight line in a plane figure, about which it revolves, to produce or generate a solid: thus, if a semicircle be moved round its diameter at rest, it will generate a sphere, the axis of which is the diameter

AXIS, in astronomy. Axis of the world, an imaginary right line conceived to pass through the centre of the earth from one pole to the other, about which the sphere of the world, revolves in its diurnal rotation.

AXIS, in conic sections, a right line dividing the section into two equal parts, and cutting all its ordinates at right angles. See CONIC SECTIONS.

AXIS, in mechanics. The axis of a balance is that line about which it moves, or rather turns about. Axis of oscillation is a right line parallel to the horizon, passing through the centre about which a pendulum vibrates.

AXIS *in peritrochio*, one of the five mechanical powers, consisting of a peritrochium or wheel, and moveable together with it about its axis.

AXIS, in optics, is that ray, among all others that are sent to the eye, which falls perpendicularly upon it, and which consequently passes through the centre of the eye.

AXIS of a glass or lens, is a right line joining the middle points of the two opposite surfaces of the glass.

AXIS of incidence, in dioptrics, is a right line perpendicular in the point of incidence, to the refracting superficies, drawn in the same medium that the ray of incidence comes from.

AXIS of refraction is a right line drawn through the refracting medium, from the point of refraction, perpendicular to the refracting superficies.

AXYRIS, in botany, a genus of the triandria order, belonging to the monœcia class of plants, and in the natural method ranking under the twelfth order, holoraceæ. There are three species, all annual, and natives of Siberia.

AYE-AYE, the name given to a singular quadruped discovered in the island of Madagascar, ranked by Gmelin under the genus "Sciurus." This animal is remarkably gentle but slothful, living chiefly underground, and scarcely able to distinguish objects by the light of day. Its food consists of worms and insects.

AYENIA, *in botany*, a genus of the pentandria order and gynandria class of plants, in the natural method ranking under the 37th order columniferæ. There are four species all natives of the West Indies.

AZELIA, in botany, the American upright honey suckle, a genus of the monogynia order, and pentandria class of plants: in the natural method ranking under the eighteenth order, bicornes. There are seven species, the principal of which are, 1. Azalea undiflora, or red American upright honey suckle, which grows to the height of twelve feet. The flowers are red. 2. Azalea viscosa bears a white flower. It is a shrub. 3. Azalea Pontica is a native of Pontus, and bears beautiful fragrant yellow flowers.

AZIMUTH, in astronomy, an arch of the horizon, intercepted between the meridian of the place, and the azimuth, or vertical circle passing through the circle of the object, which is equal to the angle of the zenith formed by the meridian and vertical circle.

AZIMUTH, *magnetial*, an arch of the horizon intercepted between the vertical circle

passing through the centre of any heavenly body, and the magnetical meridian.

Azimuth *compass*, an instrument adapted to find, in a more accurate manner than by the common sea-compass, the magnetical amplitude, or azimuth of the sun or stars.

Azimuth *dial*, one whose style or gnomon is at right angles to the plane of the horizon.

Azimuth *circles*, called azimuths, or vertical circles, are great circles of the sphere, intersecting each other in the zenith and nadir, and cutting the horizon at right angles.

AZOTE, or **Nitrogen**, in chemistry, a substance hitherto considered as elementary, existing abundantly in nature, forming full three-fourths of the atmosphere. It is a peculiar and almost characteristic ingredient of animal matter, the basis of nitric acid, and one of the constituents of volatile alkali. *Pure azote is known only in the form of gas; it is then synonymous with the phlogisticated air of Scheele and Priestley, the atmospherical mephitis of Lavoisier, and the nitrogen gas of Chaptal.*

AZURE, among painters, the beautiful blue colour, with a greenish cast, prepared from the lapis lazuli, generally called ultramarine.

Azure, in heraldry, the blue colour in the arms of any person below the rank of a baron. In the escutcheon of a nobleman, it is called saphire; and in that of a sovereign prince, Jupiter.

AZYGOS, a vein rising within the left side of the thorax, but having none like it on the other side; whence its name.

B.

B, the second letter of the alphabet, the first consonant, and the first mute; this letter is formed in the voice by a strong and quick expression of the breath, and opening of the lips, and is therefore one of the labials; as a mute it has a middle power between the smooth sound of P, and the rougher sound of F and V.

B is often used as an abbreviation: thus in music B stands for the tone above A, as $B^{\flat}$, or $^{\flat}B$, does for B flat, or the semi-tone major above A: B also stands for bass, and B. C. for *basso continuo*, or thorough bass. As a numeral, B was used by the Greeks and Hebrews to denote 2; but among the Romans, for 300, and with a dash over it (thus $\bar{B}$) for 3000. B.A. signifies Bachelor of Arts; B.L. Bachelor of Laws; and B.D. Bachelor of Divinity.

BABOON, the name of that tribe of apes which have short tails. See **Simia**.

BACCHARIS, in botany, *ploughman's spikenard*, a genus of the polygamia superflua order, belonging to the syngenesia class of plants; and in the natural method ranking under the 49th order, compositæ discoides. There are nine species, all natives of warm climates; the two following are the principal. viz. Baccharis halimifolia, or Virginia groundsel tree. 2. Baccharis ivæfolia, or African groundsel tree.

BACHELOR, or **Batchelor**, a man who still continues in the state of celibacy, or who was never married, and who, in certain cases, is subject to a double tax.

Bachelors, in a university sense, are persons that have attained to the bacca-laureat; or who have taken the first degree in the liberal arts and sciences. Before a person can be admitted to this degree at Oxford, it is necessary that he study there four years; three years more may entitle him to the degree of Master of Arts; and in seven years more he may commence Bachelor of Divinity.

BACK, in brewing a large flat vessel in which the wort is put to stand and cool before boiling. The ingredients of beer pass through three kinds of vessels; they are mashed in one, worked in another, and cooled in a third, called backs or coolers.

BACOPA, in botany, a genus of the pentandria monogynia class and order. There is but one species, an aquatic plant of Cayenne, celebrated by the inhabitants for its efficacy in curing burns.

BACTRIS, in botany, a genus of the class and order monœcia hexandria. This genus is classed among the palms: there are two species, the majus and minus, both natives of Carthagena, where the fruit is eaten.

BADGE, in naval architecture, an ornament placed on the outside of small ships, very near the stern, containing either a window or the representation of one.

BÆCKIA, in botany, so named in honour of Abraham Bæck, the intimate friend of Linnæus, who received this plant from him; of the octandia monogynia class and order. Natural order, calycanthemæ; Onagreæ Jussieu. Essential character: calyx, funnel form, five-toothed; corolla, five-petalled; capsule globular, four-celled, crowned. It is a native of China, and called there tiongina.

BAGGAGE, in military affairs, denotes the clothes, tents, utensils of divers sorts, provisions, and other necessaries belonging to an army.

BAGPIPE, a musical instrument of the wind kind, used in country places, in the north: it consists of two parts; the first a leathern bag, which blows up like a foot-ball by means of a port-vent or tube fitted to it, and stopped by a valve: the other part consists of three pipes, the first called the drone, and the second the little pipe, which pass the wind out only at the bottom; the third has a reed, and is played on by compressing the bag under the arm, when full, and opening or stopping the holes, which are eight, with the fingers. The little pipe is ordinarily a foot long; that played on thirteen inches; and the port-vent six.

BAIL, in law, the setting at liberty one arrested, upon an action either civil or criminal, upon sureties taken for his appearance at a day and place assigned. Common bail is a matter of course, being nothing but a mere form upon appearance, after personal service of the writ, and notice to appear upon the defendant.

Special bail, are two or more persons, who, after the arrest, undertake, in a certain sum, to insure the defendant's appearance at the return of the writ; this obligation is called the bail-bond.

BAILIFF, a keeper, or protector. Hence the sheriff is considered as bailiff to the crown: and the county of which he has the care, and in which he is to execute the king's writ, is called his bailiwick; so also his officers who execute writs, warrants, &c. are called bailiffs.

BAILIWICK, that liberty which is exempted from the sheriff of the county, over which liberty the lord thereof appoints his own bailiff, with the like power within his precinct as an under-sheriff exercises under the sheriff of the county.

BALÆNA, the whale, a genus of the mammalia class, and of the order of ceti. The balæna instead of teeth has a horny plate on the upper jaw, and a double fistula or pipe for throwing out water. There are four species, viz. 1. Balæna bo-ops, the pike-headed whale, which has a double pike in its snout, three fins, and a horny ridge on its back. It frequents the northern seas, and takes its name from the shape of the nose which is more narrow and sharp-pointed than on other whales. 2. Balæna musculus has a double pipe in its front, and three fins; and the under jaw is wider than the upper. It frequents the shores of Scotland, and feeds on herrings. 3. Balæna mysticetus, the great Greenland whale, has no fin on the back. It is sometimes above ninety feet in length. The head is one-third of the size of the fish: and the under lip is much broader than the upper. The tongue is composed of a soft spongy fat, which will yield above five barrels of oil. The gullet does not exceed four inches. In the middle of the head are two orifices through which it spouts water to a considerable height and with great noise. The eyes are towards the back of the head. The sense of hearing in the whale is very acute, though the external ear is not perceptible. What is termed whalebone adheres to the upper jaw, and consists of thin parallel laminæ, some of which are four yards long. The real bones of the whale are hard, porous, and full of marrow. The tail is broad, and with it the animal gives a terrible blow. The colour of the whale is various, the back of some being red, the belly white, some are black, some mottled, and others brown or white. The scarf skin is smooth, but that which covers the blubber is an inch thick. The teats of the female are on the lower part of the belly: they breed only once in two years; the whale never produces above two young ones at a time, and generally but one. The young continues a year at the breast, during which time the sailors call them *short heads*. At the age of two years they are name *stunts*, and from that time they are called *skull fish*. To what age they live is unknown. The food of the great whale is a sea insect, called the medusa, or sea blubber. 4. Balæna physalus, or fin-fish, is distinguished from the common whale by a fin on the back, near the tail. It is about the length of the former, but more slender. Its bone is of little value, and the blubber is inconsiderable. It is a fierce and swift fish, on which account the seamen neglect it; but the Greenlanders hold it in estimation for the flesh. It blows water with more violence, and to a greater height than the common whale. It feeds on herrings, and other small fish. The whale has a terrible enemy in the sword fish, which wounds it in various places, while the enormous animal endeavours to strike it with its tail, but generally without effect. There is also a shell fish which attaches itself to the body of the whale, and feeds on the fat, whence it is called the whale louse. But the most powerful enemy of the whale except man, is the orien or killer. A number of these surround the animal as dogs attack a bull. While some tear it with their teeth before, others get behind it, till the whale is torn down, when they seize upon its tongue, which is the only part they devour.

BALANCE, in mechanics, one of the simple powers which serves to find out the equality or difference of weight in heavy bodies.

BALANCE *of trade*, in commerce, the equality between the value of the commodities bought of foreigners, and the value of the native productions transported into other nations.

BALE, in commerce, is said of merchandizes packed up in cloth, and corded round very tight, in order to keep them from breaking, or preserve them from the weather.

A bale of cotton yarn is from three to four hundred weight; of raw silk, it is from one to four hundred; of dowlas, three, three and a half, or four pieces.

BALISTER, a genus of fishes of the order cartilaginei. There are twenty-four species, all remarkable for the splendour of their colours.

BALL, in the military art, comprehends all sorts of bullets for fire-arms, from the cannon to the pistol.

Cannon-balls are made of iron; musket-balls, pistol-balls, &c. are of lead. The experiment has been tried of iron balls for pistols and fusees, but they are justly rejected, not only on account of their lightness, which prevents them from flying straight, but because they are apt to furrow the barrel of the pistol, &c.

BALL *and socket*, is an instrument made of brass, with a perpetual screw, so as to move horizontally, vertically, and obliquely; and is generally used for the managing of surveying instruments, and astronomical instruments.

BALLAST, a quantity of stones, gravel, or sand, laid in a ship's hold, to make her sink to a certain depth into the water and sail upright, rendering her of a prodigious weight.

BALLET, in music, a theatrical representation of some tale or fable told in dance, or metrical action, accompanied with music. The artist who invents and superintends the rehearsal and performance of the ballet is called the ballet-master.

BALLISTA, in antiquity, a military machine used by the ancients in besieging cities, to throw large stones, darts, and javelins. It resembled our cross-bows though much larger, and superior in force.

BALLOON, in a general sense, signifies any spherical hollow body, of whatever substance it may be made, or for whatever purpose it be employed. See AEROSTATION.

BALLOTA, in botany, a genus of the didynamia gymnospermia class and order. Natural order of the verticillatæ, or labiatæ. Essen-

tial character: calyx salver-shaped, five-toothed, ten-streaked; corolla, upper-lip crenate, concave. There are six species. The European sorts, being common weeds, are never introduced into gardens.

BALLS, or **Ballets**, in heraldry, a frequent bearing in coats of arms, usually denominated according to their colours, bezants, plates, hurts, &c.

BALM, or **Baum**, in botany. See Melissa.

BALNEUM, a term used by chemists to signify a vessel filled with some matter, as sand, water, or the like, in which another is placed that requires a more gentle heat than the naked fire.

BALSAM, or **Native Balsam**, an oily, resinous, liquid substance, flowing either spontaneously, or by means of incision, from certain plants of sovereign virtue in the cure of several disorders. The principal balsams are benzoin, storax, styrax, balsam of Peru, and balsam of Tolu.

BALSAMICS, in pharmacy, softening, restoring, healing, and cleansing medicines, of gentle attenuating principles.

BALTIMORA, in botany, a genus of the polygamia necessaria order, and syngenesia class of plants. There is but one species, a native of Maryland.

BAMBOE, or **Bambou**. See Arundo.

BAMBUSA, in botany. See Arundo.

BANANA, in botany. See Musa.

BAND, in architecture, a general name for any flat, low member, or moulding, that is broad, but not very deep.

BANDEROLL, a little flag in form of a guidon, extended more in length than breadth, used to be hung out on the masts of vessels, &c.

BANISHMENT is the quitting of the realm: there are two kinds of it, one voluntary, called abjuration, and the other upon compulsion for some offence.

BANK, in commerce, the name usually given to establishments which receive the money of private persons, to keep it in security or improve it at interest, till those to whom it belongs have occasion to draw it out again. They are generally formed by a number of monied persons, who, for carrying on the business of exchanging or dealing in bullion, money, and bills, advance a considerable sum as a joint capital, which also forms a security to those who deposit money with them. The convenience of such institutions in facilitating commercial transactions, has caused them to be erected in almost every considerable city of Europe. The bank of Venice was established bout the year 1157, the bank of Genoa in 1345, the bank of Amsterdam in 1609, the bank of Hamburgh in 1619, the bank of Rotterdam in 1635, the bank of England in 1694, the bank of Scotland in 1695, the bank of France in 1716.

BANKER, a person who traffics and negociates in money, who receives and remits money from place to place, by commission from correspondents, or by means of bills or letters of exchange.

BANKRUPT, a trader whom misfortune or extravagance has induced to commit an act of bankruptcy. The benefit of the bankrupt laws is allowed to none but actual traders, or such as buy and sell, and gain a livelihood by so doing.

BANKSIA, in botany, so called in honour of Sir Joseph Banks, who first discovered it in his voyage with Captain Cook; a genus of the tetrandria monogynia class and order. Natural order of aggregatæ.

BANNER denotes either a square flag, or the principal standard belonging to a prince.

BANNERET, an ancient order of knights, or feudal lords, who, possessing several large fees, led their vassals to battle under their own flag, when summoned thereto by the king.

This order is certainly most honourable, as it never was conferred but upon some heroic action performed in the field.

BANNISTERIA, in botany, a distinct genus of plants, according to Linnæus; but accounted only a species of clematis by other botanists.

It belongs to the decandria trigynia class; its flower consists of five very large, orbicular petals; and its fruit is composed of three unilocular capsules, running into long alæ.

BANTAM *work*, a kind of painted or carved work, resembling that of Japan, only more gaudy.

BAR, in courts of justice, an inclosure made with a strong partition of timber, where the council are placed to plead causes. It is also applied to the benches, where the lawyers or advocates are seated, because anciently there was a bar to separate the pleaders from the attornies and others. Hence our lawyers, who are called to the bar, or licensed to plead, are termed barristers, an appellation equivalent to licentiate in other countries.

BARALIPTON, among logicians, a term denoting the first indirect mode of the first figure of syllogism. A syllogism in baralipton, is when the two first propositions are general, and the third particular, the middle term being the subject in the first proposition, and the predicate in the second. Thus,

Ba Every evil ought to be feared:
Ra Every violent passion is an evil;
Lip Therefore something that ought to be feared is a violent passion.

BARBA, in botany, *a beard*, a species of down with which the surface of some plants is covered. The term was invented by Linnæus, without precise explanation; it seems however to signify a tuft of hairs terminating the leaves.

BARBACAN, or **Barbican**, an outer defence, or fortification to a city or castle, used especially as a fence to the city, or walls; also, an aperture made in the walls of a fortress, to fire through upon the enemy. It is also used as a watch-tower to descry the approach of the enemy; and it sometimes denotes a fort at the entrance of a bridge, or the outlet of a city having a double wall with towers.

BARBARA, among logicians, the first mode of the first figure of syllogisms.

A syllogism in barbara, is one of which all the propositions are universal, and affirmative; the middle term being the subject of the first proposition, and attribute in the second.

BARBED *and* **Crested**, in heraldry, an appellation given to the combs and gills of a cock, when particularized for being of a different tincture from the body.

BARBER, one who makes a trade of shaving the beards of other men, for money. Besides curling the hair, and shaving, the ancient barbers trimmed the nails. Formerly some musical instrument was part of a barber's stock

in trade; and it was customary for persons above the common rank to resort to his shop, either for surgical operations, or for shaving, &c. The music was for the amusement of the waiting customers, and answered the same purpose as a newspaper in modern times. Barbers were uniformly bleeders; and the *pole* now used as a sign, was a representation of the staff which was put into the hand of a person undergoing the operation of phlebotomy. The white band which surrounds it is designed to represent the fillet that binds up the arm.

BARILLA, a kind of Spanish alkaline salt used in the glass trade. It is procured by burning to ashes several plants of the kali kind. See Soda.

BARIUM, the name given by the discoverer, Sir H. Davy, to the metallic basis of the earth barytes. It is obtained by forming pure barytes into a paste with water, and placing the mass on a plate of platinum. A small cavity is then formed in the middle of the barytes, into which a globule of mercury is to be placed. This preparation is then subjected to the action of the voltaic battery, by touching the mercury with the negative wire, and the platinum with the positive wire. In a short time an amalgam is formed consisting of mercury and barium, which, on being distilled in a curved glass tube, free from lead, parts with the mercury, while the barium remains. This metal is of a dark grey colour, inferior in lustre to cast-iron, and fusible at a red heat.

BARK, in the anatomy of plants, the exterior part of trees, corresponding to the skin of an animal.

Bark, in navigation, a little vessel with two or three triangular sails; but, according to Guillet, it is a vessel with three masts, viz. a main-mast, fore-mast, and mizen-mast.

Bark, or *Jesuist's Bark*. See Cinchona.

BARLERIA, a genus of the angiospermia order, and didynamia class of plants; and in the natural method ranking under the 40th order, personatæ. There are eleven species, all natives of the warm parts of America.

BARLEY. See Hordeum.

Barley-corn, the least of our long measures, being the third of an inch.

BAROMETER, a philosophical instrument for measuring the weight of the atmosphere. The barometer may be said to be the invention of Torricelli, who, observing that a column of water of about 33 feet was equal in weight to one of air of the same base, concluded that a column of mercury of only 29½ inches would be so too, such a column of mercury being equal in weight to 33 feet of water.

The common barometer is a glass tube about two-tenths of an inch in diameter, and its length at least thirty-one inches. This tube is filled with mercury so as not to have any air over it, the maker placing his finger on the end, immerses it in a bason of quicksilver, and then takes his finger away. The quicksilver in the tube, by its own weight endeavours to descend into that of the bason: but the external air pressing on the surface of the quicksilver in the bason without, and no air being in the tube at top, the quicksilver will continue in the tube, being raised by the air on the surface in the bason below. The usual range of the barometer in this country is from twenty-eight to thirty-one inches; when the air is pure and heavy, it raises the mercury to nearly thirty-one, and when light and full of vapours, it falls to nearly twenty-eight. In fine, *dry* weather, the air is rendered pure, free from all light vapours, and is consequently extremely heavy, so that it presses up the quicksilver. In moist rainy weather the atmosphere being charged with vapours, clouds, and fogs, the air is then sensibly lighter, and presses upon the quicksilver with less force. When high winds blow, the atmosphere is light, and the quicksilver generally is low, and it rises higher in cold weather than in warm. During frost, the air is purest and heaviest, and the barometer rises to its highest points. This instrument is also serviceable in measuring the height of mountains. In ascending mountains, quicksilver is found to sink about a tenth of an inch in ninety feet; so that if the quicksilver fall an inch, we have ascended near nine hundred feet; but this is subject to variations, from change of temperature and other causes, which render various corrections necessary. The general method, however, of determining altitudes by the barometer and thermometer is extremely useful and convenient; and ingenious rules are given by Dr. Hutton, Dr. Gregory, Sir Henry Englefield, and others, to facilitate the computation.

BARON, a degree of nobility next below a viscount, and above a baronet.

Barons *of the cinque-ports* are members of the house of commons, elected by the five ports, two for each port.

Baron *and* **Feme**, in law, a term used for husband and wife, who are deemed but one person.

Baron *and* **Feme**, in heraldry, is when the coats of arms of a man and his wife are borne per pale in the same escutcheon, the man's being always on the dexter side, and the woman's on the sinister.

BARONET, a modern degree of honour which is hereditary, and has the precedence of all knights, except those of the garter, bannerets, and privy-counsellors.

BARONY, the honour and territory which gives title to a baron, whether he is a layman or a bishop.

Barony, in Ireland, the name of the divisions of the counties, answering to English hundreds.

BARRATRY, in a ship-master, is his cheating the owners. If goods delivered on shipboard are embezzled, all the mariners ought to contribute to the satisfaction of the party who lost his goods, by the maritime law; and the cause is to be tried in the admiralty.

BARREL, a measure of liquids. The English barrel, wine-measure, contains the eighth part of a tun, the fourth part of a pipe, and one-half of an hogshead; that is, it contains thirty-one gallons and a half: a barrel, beer-measure, contains thirty-six gallons. The barrel of beer, vinegar, or liquor preparing for vinegar, ought to contain thirty four gallons, according to the standard of the ale quart.

Barrel also denotes a certain weight of several merchandizes; thus a barrel of Essex butter weighs 106lbs, and of Suffolk butter 256lbs. The barrel of herrings ought to contain 32 gallons wine measure, containing about a thousand herrings. The barrel of salmon must contain 42 gallons. The barrel of eels the same. The barrel of soap must weigh 256lbs.

BARRERIA, in botany, a genus of the syngenesia monogamia class and order. The essential character is, calyx, five-toothed, very small; corolla, five-parted; style, short; stigma, trifid. There is but one species, a tree of Guiana, which rises to the height of 40 or 50 feet.

BARRICADE, or BARRICADO, a warlike defence, consisting of empty barrels and such like vessels filled with earth, stones, carts, trees cut down, against an enemy's shot, or assault; but generally trees cut with six faces, which are crossed with battoons as long as a half-pike, bound about with iron at the feet.

BARRIER, in fortification, a kind of fence made at a passage, retrenchment, &c. to prevent the entrance of either horse or foot.

BARINGTONIA, in botany, a genus of the polyandria order, and monadelphia class of plants, the characters of which are: female, the calyx diphyllous above, with a drupa, which it crowns; and the seed is a quadrilocular nut. There is is but one species, a native of China, and Otaheite.

BARRISTER, in common law, a person qualified and empowered to plead the cause of clients in courts of justice. Barristers are distinguished into outer and inner: outer barristers are those of five years' standing, and who plead without the bar: inner barristers are those who, being king's counsel, have the privilege of pleading within the bar.

BARROW, a name usually given to those hillocks or mounds of earth which were anciently raised over the bodies of deceased heroes, and persons of distinguished character. These are considered by some antiquarians as the most ancient sepulchral monuments in the world.

BARRULET, in heraldry, the fourth part of the bar, or the one half of the closset: an usual bearing in coat-armour.

BARRULY, in heraldry, is when the field is divided bar-ways, that is, across from side to side, into several parts.

BARRY, in heraldry, is when an escutcheon is divided bar-ways, that is, across from side to side, into an even number of partitions, consisting of two or more tinctures, interchangeably disposed.

BARRY-*bendy* is when an escutcheon is divided evenly, bar and bend-ways, by lines drawn transverse and diagonal, interchangeably varying the tinctures of which it consists.

BARRY-*pily* is when a coat is divided by several lines drawn obliquely from side to side, where they form acute angles.

BARTERING, in commerce, the exchanging of one commodity for another, or the trucking wares for wares, among merchants. Bartering was the original and natural way of commerce, there being no buying till money was invented, though in exchanging, both parties are buyers and sellers.

BARTSIA, in botany, so named from Dr. Bartsch, the intimate friend of Linnæus, a genus of the didynamia angiospermia class of plants, whose flower consists of one petal, having the upper lip longest; the seeds are numerous, small, angular, and inclosed in capsules. There are five species.

BARYTES, in mineralogy, an earth discovered by Scheele in 1774: he gave it the name of terra ponderosa, from its weight, and Kirwan that of barytes, by which it is now generally called. Its taste is harsh and caustic, and it is a powerful poison. It tinges vegetable blues green, and decomposes fixed bodies; it has no action on metals; but it readily combines with several metallic oxides.

BASALTES, in natural history, a kind of stone of a fine texture, resembling polished steel. It is never found in strata, but standing up in the form of regular angular columns composed of a number of joints, fitted to each other with the greatest exactness. The grandest specimen in the world, is that called the Giant's Causeway in Ireland, where it rises far up the country, runs into the sea, and rises again on the opposite shore. Basalt is used in building and paving, also as an ingredient in the manufacture of glass bottles; when calcined and pulverized it makes excellent mortar, which hardens under water.

BASE, in geometry, the lowest side of the perimeter of a figure; thus, the base of a triangle is properly the lowest, or that which is parallel to the horizon.

BASE *of a solid figure*, the lowest side, or that on which it stands.

BASE *of a conic section*, a right line in the hyperbola and parabola, arising from the common intersection of the secant plane, and the base of the cone.

BASE, in architecture, is the lower part of a column and pedestal.

The base of a column is that part between the shaft and the pedestal, if there be one; or, if there be none, between the shaft and the plinth.

BASE, in fortification, the exterior side of the polygon, or that imaginary line which is drawn from the flanked angle of a bastion to the opposite angle.

BASE, in gunnery, the least sort of ordnance, the diameter of whose bore is 1¼ inch, weight 200 pounds, length 4 feet, load 5 pound, shot 1½ pound weight, and diameter 1⅛ inch.

BASE *line*, in perspective, the common section of a picture, and the geometrical plane.

BASE, or **BASIS**. By this term modern chemists express either species or families of saline matters, which differ with regard to the acid, but agree as to the alkali, earth, or metallic oxide, which they contain.

BASE, in law. Base estate, such as base tenants possess. Base tenure, the holding by villenage or other customary service. Base fee, is to hold in fee at the will of the lord Base court, any court not of record.

BASELLA, CLIMBING NIGHTSHADE, from Malabar, a genus of the pentandria class, and trigynia order of plants, and in the natural method ranking under the 12th order, holoraceæ. The calyx is wanting; the corolla is seven-cleft; there is one seed. There are four species, but the two following are the principal:

1. Basella alba, with oval leaves, and small flowers and fruit.

2. Basella rubra, with red leaves and simple footstalks, has thick, strong, succulent stalks and leaves, which are of a deep purple colour.

BASEMENT, in architecture, a base con-

tinued a considerable length, as round a house, room, &c.

BASKETS are made of rushes, splinters, or willows, which last, according to their manner of growth, are called osiers and sallows.

When the osiers are cut down, those that are intended for white work, such as baskets used in washing, are to be stripped of their bark or rinds while green, by a sharp instrument fixed into a block: before they are worked up, they must be soaked in water, which gives them flexibility.

Hampers and other coarse work are made of osiers without any previous preparation except soaking.

The ancient Britons were noted for their ingenuity in making baskets, which they exported in large quantities. They were of very elegant workmanship, and bore a high price.

BASS, in music, that part of a concert which is most heard, which consists of the gravest and deepest sounds, and which is played on the largest pipes or strings of a common instrument, as of an organ, lute, &c. or on instruments larger than ordinary, for that purpose, as bass-viols, bassoons, bass hautboys, &c. The bass is the principal part of a musical composition, and the foundation of harmony; for which reason it is a maxim among musicians, that when the bass is good, the harmony is seldom bad.

Bass, *counter*, is a second or double bass, where there are several in the same concert.

BASSIA, in botany, a genus of the dodecandria class of plants, and monogynia order, the characters of which are: calyx, quadriphyllous; corolla, octofid, and tube, inflated; stamina, 16; drupe, quinquespermous. There are three species, natives of Malabar.

BASSOON, a musical instrument of the wind sort, blown with a reed, furnished with eleven holes, and used as a bass in a concert of hautboys, flutes, &c.

BASSORIA, a genus of the penandria monogynia class and order: calyx, five-cleft, spreading, with a short tube; berry, ovate, knobbed, and many-seeded. There is but one species, an herbaceous plant of Guiana.

BASSO-*relievo*, or Bass-relief, a piece of sculpture, where the figures do not project far above the plane on which they are formed. Whatever figures are thus cut, are said to be done in relief, or relievo; and when the work is low, flat, and but a little raised, it is called low relief: when a piece of sculpture, or a medal, has its figure raised so as to be well distinguished, it is called bold, and we say its relief is strong.

BASTARD, a natural child, or one born out of wedlock, consequently illegitimate. The incapacity of a bastard consists in this, that he cannot be heir to any one; nor can he have heirs but of his own body. A bastard may, however, be made legitimate by an act of parliament.

BASTION, in the modern fortification, a mass of earth, faced usually with sods, sometimes with brick, and rarely with stone, standing out from a rampart. A bastion consists of two faces and two flanks; the faces include the angle of the bastion; and their union makes the saliant angle, called also the angle of the bastion; and the union of the two faces to the two flanks makes the side-angles, called also the shoulders, or epaules; and the union of the two other ends of the flanks to the two curtains makes the angles of the flanks. See Fortification.

BASTON, or Batoon, in heraldry, a kind of bend, having only one third of the usual breadth.

BAT. See Vespertilio.

BATIS, in botany, a genus of the tetrandria order, and diœcia class of plants; of the male, the amentum is four-ways imbricated, and both the calyx and corolla are wanting: of the female, the amentum is ovate; the involucrum diphyllous; calyx and corolla wanting; the stigma is bilobate and sessile; the berries condunate, and four-seeded. There is but one species, a native of Jamaica.

BATTALION, a body of infantry, ranged in form of battle, and ready to engage.

A battalion usually contains from 500 to 800 men; but the number it consists of is not determined.

BATTEN, a name that workmen give to a scantling of wood from two to four inches broad, and about one inch thick; the length is undetermined.

BATTERY, in military affairs, implies any place where cannon or mortars are mounted, either to attack the forces of the enemy, or to batter a fortification: hence batteries have various names, according to the purposes they are designed for.

Battery, in law, the striking, beating, or offering any violence to another person, for which damages may be recovered. But if the plaintiff made the first assault, the defendant shall be quit, and the plaintiff amerced to the king for his false suit.

BATTLE, in the military art, has ever been the last resource of good generals. A situation where chance and accident often baffle and overcome the most prudential and most able arrangements, and where superiority of numbers by no means ensures success, is such as is never entered into without a clear necessity for so doing.

Battle *array*, or line of *battle* is the form of drawing up the army for an engagement: this generally consists of three lines, viz. the front, the rear, and the reserve.

Battle, *naval*, the same with a sea-fight, or engagement between two fleets of men of war. Before a naval battle every squadron usually subdivides itself into three equal divisions, with a reserve of certain ships out of every squadron to bring up their rear.

BATTLEMENTS, in architecture, are indentures or notches in the top of a wall or other building, in the form of embrasures, for the sake of looking or firing through them.

BAUHINIA, *mountain ebony*, a genus of the monogynia order, and decandria class of plants, ranking in the natural method under the thirty-third order lomentaceæ. There are thirteen species, all trees and shrubs, propagated by seeds. The principal are, 1. Bauhinia aculeata with a prickly stalk. It is common in America and the West Indies, where it is called the savin tree. 2. Bauhinia acuminata, with oval leaves. It is a native of both the East and West Indies. The wood is hard with

black veins. 3. Bauhinia divaricata, with oval leaves, whose lobes spread different ways. It grows in Jamaica. 4. Bauhinia tomentosa, with heart-shaped leaves, is a native of Campeachy, and grows to the height of fourteen feet.

BAYONET, in the military art, a short dagger made to fit on the muzzle of a firelock, and so fixed that the soldier may discharge his piece while it is on, and be ready to charge.

BAYS, in commerce, a sort of open woollen stuff, having a long nap, sometimes frized, and sometimes not. It is chiefly manufactured in Essex.

BEACON, a public signal, to give warning against rocks, shelves, invasions, &c.

The corporation of the Trinity-house are empowered to set up beacons wherever they shall think necessary; and if any destroy or take them down, he shall forfeit 100*l.* or be *ipso facto*, out-lawed.

BEAD, in architecture, a round moulding on the edge of a piece of stuff in the Corinthian and Roman orders. Also an ornament made of glass, &c. for necklaces. *Bead proof*, among distillers, is a fallacious mode of determining the strength of spirits from the continuance of the bubbles or beads raised on the surface.

BEAGLE. See *Canis*.

BEAM, in architecture, the largest piece of wood in a building, which lies across the walls, and serves to support the principal rafters of the roof, and into which the feet of these rafters are framed. No building has less than two of these beams, viz. one at each end.

Beams *of a ship*, are the great main cross-timbers which hold the sides of the ship from falling together, and which also support the decks and orlops. The main beam is next the main-mast, and from it they are reckoned by first, second, third, beam, &c. The greatest beam of all is called the mid-ship beam.

Beam-*compass*, an instrument consisting of a square wooden or brass beam, having sliding sockets, that carry steel or pencil points: they are used for describing large circles, where the common compasses are useless.

Beam, in heraldry, the term used to express the main horn of a hart or buck.

BEAN. See Vicia, and Phaseolis.

BEAR. See Ursus.

Bear, in astronomy, a name given to two constellations, called the greater and lesser bear, or ursa major, and ursa minor.

Bear, a species of barley cultivated in Scotland and Ireland, and the northern parts of England. It is not esteemed so good for malting as the common barley.

Bear, in heraldry. He that has a coat of arms is said to bear in it the several charges or ordinaries that are in his escutcheon.

BEAR'S *breech*. See Acanthus.

BEARER, in architecture, a post, or brick wall, trimmed up between the two ends of a piece of timber, to shorten its bearing, or to prevent its bearing with the whole weight at the ends only.

BEARING, in navigation and geography, the situation of one place from another, with regard to the points of the compass.

Bearing, in the sea language: When a ship sails towards the shore, before the wind, she is said to bear in with the land or harbour. To let the ship sail more before the wind, is to bear up To put her right before the wind, is to bear round. A ship that keeps off from the land, is said to bear off. When a ship that was to windward comes under another ship's stern, she is said to bear under her lee, &c.

BEAT, in music, a transient grace note, struck immediately before the note it is intended to ornament. The beat always lies half a note beneath its principal, and should be heard so closely upon it, that they may almost seem to be struck together.

BEAVER. See Castor.

BECHERA, in botany, a genus of the pentandria digynia class and order. Calyx, five cleft, superior, with a globular tube; coral, five-petalled; capsule, two-celled, two-valved. One species.

BED, in masonry, a course or range of stones; and the joint of the bed is the mortar between two stones placed over each other.

BED-*chamber, lords of*, in the British customs, 14 lords who attend in their turns, each a week, during which time they lie in the king's bed-chamber, and wait on him when he dines in private.

BEDOUINS, tribes of Arabs, who live in tents, and are dispersed all over Arabia, Egypt, and the north of Africa.

BEE, in zoology. See Apis.

BEECH. See Fagus.

BEER. See Brewing.

BEESTINGS, a term used by country-people for the first milk taken from a cow after calving.

BEET. See Beta.

BEETLE. See Scarabæus.

Beetle also denotes a wooden instrument for driving piles, &c.

It is likewise called a stamper, and by paviors a rammer.

BEGONIA, a genus of plants of the monœcia polyandria class and order, whose characters are: the male flower has no calyx, but many petals; the female is of the rosaceous kind, and composed of several petals in a circular form, on a foliated cup, which becomes a trigonal alated capsule, containing small seeds. There are thirteen species, chiefly stove-plants.

BEJARIA, a genus of plants of the dodecandria monogynia class and order: calyx is seven cleft; petals, seven; stamina, fourteen; berry, seven-celled, and many seeded. The species are two, one a tree, and the other a shrub, natives of New Grenada.

BELL, a well-known machine, ranked by musicians among the musical instruments of percussion. The music of bells is altogether melody; but the pleasure arising from it consists in the variety of interchanges, and the various successions and general predominance of the consonances in the sounds produced. The metal of which a bell is made, is a composition of tin and copper, or pewter and copper; the proportion one to the other is almost 20 pounds of pewter, or 23 pounds of tin, to 100 weight of copper.

The sound of a bell consists in a vibratory motion of its parts, much like that of a musical chord. The stroke of the clapper must necessarily change the figure of the bell, and of a round make it oval; but the metal having a

great degree of elasticity, that part will return back again which the stroke drove farthest off from the centre, and that even some small matter nearer the centre than before; so that the two parts which before were extremes of the longest diameter, do then become those of the shortest; and thus the external surface of the bell undergoes alternate changes of figure, and by that means gives that tremulous motion to the air, in which the sound consists.

BELLA-*donna*. See AMARYLLIS and ATROPA.

BELLES *Lettres*, a word absurdly introduced from the French, and noted here only to reprobate the contemptible practice of debasing the simple majesty of our native language, by wretched Gallicisms. The French writers themselves have no determinate idea affixed to this phrase; some applying it to polite literature only, and some extending it to the whole scope of human learning, even to mathematics.

BELLIS, the daisy, a genus of the syngenesia class, and polygamia superflua order of plants; in the natural method ranking under the 49th order, compositæ discoidæ. There are two species, and many varieties. 1. Bellis annua is a low annual plant, which grows on the Alps, and the hilly parts of Italy. 2. Bellis perennis, or common daisy, grows naturally in pasture lands. The varieties of the garden daisy are the red and white; the double variegated; the childing, or hen and chicken daisy, and the cockscomb daisy.

BELLIUM, a genus of the syngenesia, polygamia superflua class and order. The essential character is; cal. with equal leaflets; seeds conic, with chaffy eight-leafed crown, and awned down; recept. naked. There are two species, natives of Italy and the Levant, in many respects resembling the daisy in habit and appearance.

BELLONIA, a genus of the monogynia order, and pentandria class of plants. Flower wheel-shaped; germen under the receptacle of the flower which afterwards becomes a turbinated seed-vessel ending in a point having one cell filled with round seeds. There are two species. 1. Bellonia aspera or shrubby bellonia, which is common in the West Indies. 2. Bellonia spinosa, a native of Hispaniola.

BELLOWS, a machine so contrived as to expire and respire the air alternately by enlarging and contracting its capacity. The action of bellows depends on this: that the air which enters is compressed when they are closed, and flows out of the pipe with a velocity proportioned to the force by which it is compressed. The bellows of smiths and founders are worked by means of a rocker. The bellows of a large organ are worked by a man called the blower; but in small organs by the foot of the player.

BELLY, in anatomy, the same with what is more usually called abdomen, or rather the cavity of the abdomen. See ANATOMY.

BENCH, FREE, signifies that estate in copybold lands, which the wife, being espoused a virgin, has, after the decease of her husband, for her dower, according to the custom of the manor.

BEND, in heraldry, one of the nine honourable ordinaries, containing a third part of the field when charged, and a fifth when plain

BENDING, in the sea language, the tying two ropes or cables together: thus they say, bend the cable; that is, make it fast to the ring of the anchor: bend the sail, make it fast to the yard.

BENDS, in a ship, the same with what are called wails, or wales; the outmost timbers of a ship's side, on which men set their feet in climbing up.

BENZOIN, a dry and solid resin, brought from the East Indies, particularly from the kingdom of Siam, and the islands of Java and Sumatra. It is brittle, and breaks vitreous. When rubbed, it emits a fragrant odour; and hen heated sufficiently, lets the benzoic acid escape. It is soluble in alcohol, but insoluble in water.

BERBERIS, the barberry, a genus of the monogynia order and hexandria class of plants. Calyx, six leaves; petals, six, with two glands at the ungues; stylus, none; the berry has two seeds. There are four species. 1. Berberis cretica, grows to the height of three or four feet. 2. Berberis illicifolia, having leaves like the holm oak. 3. Berberis Sibirica, a small low shrub. 4. Berberis vulgaris, the common barberry which grows wild in hedges in many parts of England. It is cultivated for its fruit which makes a pickle. Its height is from eight to ten feet, with many stalks. The flowers are yellow, and succeeded by an oval fruit, which are at first green, and when ripe become red. There are two or three varieties of this shrub.

BERGAMOT, the name of a fragrant essence extracted from a fruit which is produced by ingrafting a branch of a lemon-tree upon the stock of a bergamot-pear.

BERGESA, a genus of the class and order decandria monogynia. The essential character is, calyx, five-parted; petals, five; berry, subglobular, one-celled, with five seeds.

There is one species, a leafy tree, a native of the East Indies.

BERGIA, a genus of the class and order decandria pentagynia. The essential character is, calyx, five-parted; petals, five; capsule, one, globular, with swellings, five-celled, five-valved, valves resembling petals; seeds many.

There are two species, the B. capensis and glomerata, both natives of the Cape.

BERRY, a round fruit, for the most part soft, and covered with a thin skin, containing seeds in a pulpy substance; but if it is harder, or covered with a thicker skin, it is called pomum, apple.

BERYL, a pellucid gem of a bluish green colour; whence it has been denominated *aqua marina*. It is found in the East Indies, Peru, Siberia, and Tartary, where its crystals are sometimes a foot in length. There are two species of this stone: viz. the oriental or precious beryl, and occidental or schorlous beryl: the former contains silex, alumine, glucine, lime, and oxide of iron; and the latter silex, alumine, lime, and water.

BESANTS, in heraldry, round pieces of gold, without any stamp, frequently borne in coats of arms.

BESLERIA, a genus of the angiospermia order, and didynamia class of plants. There are six species; the principal of which are, 1. Besleria cristata, with stalks growing single and a five-leafed involucrum. The calyx is scarlet; and the corolla yellow. 2. Besleria

lutea, with simple footstalks growing in clusters, and spear-shaped leaves. The flowers are yellow. 3. Besleria melittifolia, with branching footstalks and oval leaves. They are all natives of America, and in this country are stove plants, but are not remarkable for beauty, or any other property.

Beta, the *beet*, a genus of the pentandria digynia class and order of plants, and in the natural method ranking under the 12th order, holoraceæ. The calyx has five leaves; there is no corolla; the seeds are kidney-shaped, and situated within the base of the calyx. There are four species. The root of the beet affords a considerable quantity of sugar, and has lately been cultivated for the purpose of extracting it to some extent in Germany. It is likewise said, that if beet roots be dried in the same manner as malt, after the greater part of their juice is pressed out, very good beer may be made from them.

BETEL, or **BETLE**, in botany, a kind of long pepper, found in Malabar, and other parts of the East Indies.

BETONICA, *betony*, a genus of the gymnospermia order, and didynamia class of plants; in the natural method ranking under the 42d order, verticillatæ. The calyx is awned, upper lip of the corolla ascending and flattish; and the tube cylindric. There are seven species; the chief of which are, 1. Betonica orientalis, the oriental betany. 2. Betonica stricta, the greater Danish betany. 3. Betonica incana, the hoary Italian betany, which has a flesh-coloured flower. 4. Betonica officinalis. This is a low plant, and grows in woods and shady places.

BETULA, the alder-tree or birch, a genus of the tetrandria order, and monœcia class of plants, ranking in the natural method under the 50th order, amentaceæ. The male calyx is monophyllous, trifid, and biflorus; the corolla parted into four segments: female calyx monophyllous, trifid and biflorus; seeds winged on both sides. Of the species, which are fifteen, the principal are, 1. Betula alba, or common birch tree. It grows to a considerable height and size, in a good soil and situation. 2. Betula alnus, or the alder tree, is of a straggling growth. It flourishes in swampy places, the roots poison the herbage, and rot the soil. 3. Betula lenta, the Canadian birch, grows to the height of above sixty feet. There are four varieties. 4. Betula nana, the dwarf birch, with roundish leaves, grows naturally in the northern parts of Europe, and on the Alps. 5. Betula nigra, or the black Virginian birch tree, which grows to the height of sixty feet and upwards. The leaves are broad, and the branches are spotted. There are several varieties.

BEVEL, among masons, carpenters, joiners, and bricklayers, a kind of square, one leg whereof is frequently crooked, according to the sweep of an arch or vault. It is moveable on a centre, and so may be set to any angle. The make and use of this instrument are pretty much the same as those of the common square and mitre, except that those are fixed, the first at an angle of ninety degrees, and the second at forty-five; whereas the bevel being moveable, it may in some measure supply the place of both, which it is chiefly intended for, serving to set off or transfer angles, either greater or less than ninety or forty-five degrees.

BEVILE, in heraldry, a thing broken or opening like a carpenter's rule.

BEZOAR, an antidote or medicine intended to expel poison. The *oriental bezoar* is a round stone, varying in size from a pea to a small walnut. It is of an olive or greenish brown colour, and smooth and glossy on the surface. When broken it is found to consist of many coats of stony matter, formed upon a piece of wood, or the seed of a fruit. This drug is of great price, but seems to possess a higher name than real value. It comes from Persia and other parts of the East, and one kind is found in Mexico. Bezoars are supposed to be concretions formed in the stomach or intestines of different animals.

Three bezoars sent to Buonaparte by the king of Persia, were found by Berthollet to be nothing but woody fibre agglomerated.

BIBLE, *the book*, a name given by Christians, by way of eminence, to a collection of the sacred writings.

Various versions of the Sacred Volume are to be met with; some of them are reckoned valuable, in consequence of their antiquity: being made at different periods, by men whose theological sentiments were in some respects different; and rendered into the principal languages, and dialects in use in different parts of the world, it is naturally to be expected that those versions should, in some respect, vary from each other. But after all the laborious research of Biblical critics, it is allowed that even the most important of these differences do in no wise affect the leading object of divine revelation, which is to make known to man the character of God; to acquaint him with the reality of a future state of existence; and the inseparable connection between the nature of his actions here, and the felicity or misery of his state hereafter.

BICEPS, in anatomy, the name of several muscles. See ANATOMY.

BIDENS, a genus of the syngenesia polygamia, æqualis class and order, and in the natural method ranking under the 49th order, compositæ oppositifoliæ. The receptacle is paleaceous; the pappus has erect scabrous awns; and the calyx is imbricated. Of this genus there are fourteen species; but none of them appear to merit notice, except the bidens tripartita, frequently found by the sides of rivulets, ditches, and lakes in England.

BIENNIAL *plants*, are those that have two years' duration, or that are in their prime the first and second summers. They consist both of esculent and flowering plants.

BIGAMY, in law, is where a person marries a second wife, or husband, the first being alive, for which the punishment was formerly death, as in cases of felony; but it is now usually punished with a long imprisonment, or even transportation.

BIGNONIA, the *trumpet-flower*, in botany, a genus of the didynamia angiospermia class. The flower is monopetalous, with a mouth campanulated, and divided into five segments: the fruit is a pod with two cells and two valves, containing several imbricated, compressed, and winged seeds. There are twenty-seven species, mostly trees and shrubs, inhabitants of the hot climates of the East and West Indies, and eminently beautiful.

BILBOES, a punishment at sea, answering to the stocks at land. The offender is laid in irons, or stocks, which are more or less ponderous, according to the quality of the offence of which he is guilty.

BILDGE of a ship, the bottom of her floor, or the breadth of the place the ship rests on when she is aground. Therefore, bildge-water is that which lies on her floor.

BILE, a yellow, bitter juice, separated from the blood in the liver, collected in the porus biliarius and gall-bladder, and thence discharged by the common duct into the duodenum.

BILL, an instrument of iron, edged in the form of a crescent, and adapted to a handle. It is used by plumbers, to perform several parts of their work; by basket-makers, and by gardeners. When short, it is called a hand-bill; and when long a hedge-bill.

Bill, in law, is a declaration in writing, expressing the wrong the complainant had suffered, or some fault committed against some law or statute of the realm; and this bill is sometimes addressed to the lord chancellor, especially for unconscionable wrongs done to the complainant; and sometimes to others having jurisdiction. In criminal cases, when a grand jury upon presentment, or indictment, finds the same to be true, they indorse on it *billa vera*, and thereupon the offender is said to stand indicted.

Bill *of credit*, is that which a merchant or banker gives to a person empowering him to receive money from his correspondents in foreign countries.

Bill *in equity*, is a petition, addressed to the lord chancellor, or exchequer, with which a suit in chancery or the exchequer commences.

Bills *of exchange*. A bill of exchange is an order or request in writing, addressed by one person to another, to pay a certain sum of money on demand, or at a time specified, to a third person, or to his order; or it may be made payable to bearer.

If a bill is made payable to bearer, it is assignable by delivery only; but if it is payable to order, it must be transferred by indorsement and delivery. The person making or drawing the bill is called the *drawer*; the person to whom it is addressed the *drawee*; who, when he has undertaken to pay the amount, is termed the *acceptor*. The person in whose favour the bill is drawn is called the *payee*; but if he appoints some other person to receive the money, he is then termed the *indorser*, and the person so appointed the *indorsee*.

A promissory note, or note of hand, is an engagement in writing, to pay a sum specified at the time therein limited, to a person therein named, or sometimes to his order, or often to the bearer at large: this is also made assignable, and indorsable.

Bill *of entry*, an account of the goods entered at the custom-houses both inwards and outwards.

Bill *of lading*, an acknowledgment signed by the master of a ship, and given to a merchant, &c. containing an account of the goods which the master has received on board from that merchant &c. with a promise to deliver them at an intended place for a certain sum.

Bill *in parliament*, a paper containing propositions offered to the houses, to be passed by them, and then to be presented to the king to pass into an act or law.

Bill *of sale*, is when a person wanting a sum of money delivers goods as a security to the lender, to whom he gives this bill, impowering him to sell the goods in case the sum borrowed is not repaid, with interest, at the appointed time.

Bill *of store*, a licence granted at the custom-house to merchants, by which they have liberty to carry, custom-free, all such stores and provisions as they may have occasion for during their voyage.

Bill *of sufferance*, a licence granted to a merchant, at the custom-house, suffering him to trade from one English port to another without paying custom.

BILLET, in heraldry, a bearing in form of a long square. They are supposed to represent pieces of cloth, of gold, or silver: but Guilim thinks they represent a letter sealed up; and other authors take them for bricks.

BINARY *arithmetic*, a species of arithmetic, invented by Leibnitz, wherein unity, or 1 and 0, are only used. The cipher multiplies every thing by 2, as in common arithmetic Thus, 1 is one; 10, two; 11, three; 100, four, 101, five; 110, six; 111, seven; 1000, eight; 1001, nine; 1010, ten. The design of the inventor appears to have been to expedite the discovery of the properties of numbers, and the construction of tables; but he does n[illegible]mend this method for common use, because of the great number of figures requisite to express a number.

BINDWEED. See Convolvolus.

BINOMIAL, in algebra, a root consisting of two members connected by the sign + or —. Thus $a+b$ and 8—3 are binominals, consisting of the sum and difference of these quantities.

The powers of any binominal are found by a continual multiplication of it by itself. For example, the cube or third power of $a+b$ will be found by multiplication to be $a^3+3a^2b+3ab^2+b^3$; and if the powers of $a-b$ are required, they will be found the same as the preceding, only the terms in which the exponent of b is an odd number will be found negative. Thus, the cube of $a-b$ will be found to be $a^3+3a^2b+3ab^2-b^3$; where the second and fourth terms are negative, the exponent of b being an odd number of these terms. In general, the terms of any power of $a-b$ are positive and negative by turns. See Algebra.

BIPED, an animal with only two legs. Men and birds are bipeds.

The term is used for a genus of reptiles that belong to the lizard family. These have a very long body covered with scales, and the toes of the two little feet are armed with nails.

BIQUADRATIC *power*, in algebra, the fourth power or squared square of a number, as 16 is the biquadratic power of 2; for 2×2 is 4, and 4×4 is equal to 16.

Biquadratic *root of a number*, is the square root of its square root: thus the biquadratic root of 81 is 3; for the square root of 81 is 9, and the square root of 9 is 3.

Biquadratic *equation*, an equation where the unknown quantity of one of the terms has four dimensions.

Any biquadratic equation may be generated

by the multiplication of four simple equations; or it may be formed of two quadratic equations.

BIRCH. See ALDER.

BIRD. See AVES.

BIRD-CATCHING, is the art of taking birds, or wild-fowl, by bird-lime, nets, decoys, &c. The nets used by bird-catchers are about twelve yards long, and two and a half wide; which are spread on the ground at such a distance from each other, that when turned over, they shall coincide. The remaining apparatus consists of lines so fastened to the nets, that the bird-catcher is able by a sudden pull to draw the net over the birds that may alight between the parallel sides. These birds are enticed by others denominated call-birds, which are generally linnets, gold-finches, green-finches, wood-larks, yellow-hammers, tit-larks, and bul-finches. When these birds perceive the approach of the wild birds, the intelligence is announced from cage to cage with the utmost extacy. The note by which they invite them down, has so powerful an ascendancy over the wild birds, that the moment they hear it, they alight on a spot within twenty yards of the bird-catchers.

Birds are also caught in traps, and frequently by nooses of hair. In this way, great numbers of wheatears are annually taken on the various downs of England. Wild ducks are taken in vast numbers every winter on our coasts by means of decoys. Grouse and partridges are taken by means of nets, chiefly by night. Pheasants are sometimes taken by night, by holding flaming sulphur under the trees on which they are observed to perch, the suffocating effluvia of which make them fall senseless.

BIRDS, in heraldry, according to their several kinds, represent either the contemplative or active life. They are the emblems of liberty, expedition, readiness, swiftness, and fear.

BIRDLIME. The best birdlime is made of the middle bark of the holly, boiled seven or eight hours in water, till it is soft and tender; then laid in heaps in pits in the ground and covered with stones, the water being previously drained from it; and in this state left for two or three weeks to ferment, till it is reduced to a kind of mucilage. This being taken from the pit is pounded in a mortar to a paste, washed in river water, and kneaded, till it is freed from extraneous matters. In this state it is left four or five days in earthen vessels, to ferment and purify itself, when it is fit for use.

It may likewise be obtained from the mistletoe, the viburnum lantana, young shoots of elder, and other vegetable substances.

BIRTHWORT. See ARISTOLOCHIA.

BISCUIT, *sea*, is a sort of bread much dried, to make it keep for the service of the sea. It was formerly baked twice, or oftener, and prepared six months before the embarkation. It will keep good a whole year.

BISCUTELLA, *buckler mustard*, or bastard Mithridate mustard: a genus of the tetradynamia siliculosa class and order of plants; and in the natural method ranking under the 39th order, siliquosæ. The silicula is flat, compressed, rounded above, and below two-lobed. There are six species, all natives of France, Italy, Spain, and Germany.

BISECT, to divide into two parts. The rational horizon bisects the globe into two equal parts.

BISERRULA, a genus of the decandria order, and diadelphia class of plants; and in the natural method ranking under the 32d order, papilionaceæ: the legumen is bilocular and flat, and the partition contrary. Of this genus there is only one species known, viz. Biserrula pelecina, an annual plant, with purple flowers; a native of the south of Europe.

BISHOP, a prelate, or person who is set apart for the spiritual government of a diocese. Whether the terms *bishop* and *priest* are used indiscriminately in the New Testament, has long been a point of dispute among the sects into which the Christian world is divided. But whatever difficulties this subject may be attended with, certain it is that the common application is a gross perversion of the term bishop. Indeed the character of a bishop, as delineated in the New Testament, forms a perfect contrast with the character to which the epithet is commonly applied. The bishop of the New Testament is a man who superintends in the church of God from the *purest* and most *disinterested* motives; the very nature of his office implies that he is to teach truth so as to lead his charge to a good life; that he is not to claim to himself power over their souls; that he is to maintain his dignity solely on the ground of the holiness of his office; in one word, the man who holds the office must be blameless, and ready to the performance of every good work.

BISMUTH is a metal of a yellowish or reddish-white colour, little subject to change in the air. It is somewhat harder than lead, and is scarcely, if at all malleable; being easily broken, and even reduced to powder, by the hammer. The internal face, or place of fracture, exhibits large shining plates, disposed in a variety of positions; thin pieces are considerably sonorous. At a temperature of 480° Fahrenheit, it melts, and its surface becomes covered with a greenish-grey, or brown oxide. A stronger heat ignites it, and causes it to burn with a small blue flame; at the same time that a yellowish oxide, known by the name of flowers of bismuth, is driven up. This oxide appears to rise in consequence of the combustion; for it is very fixed, and runs into a greenish glass when exposed to heat alone.

BISSEXTILE, or *leap-year*, a year consisting of 366 days, and happening every fourth year, by the addition of a day in the month of February, which that year consists of 29 days. And this is done to recover the 6 hours which the sun takes up nearly in his course more than the 365 days commonly allowed for it in other years.

BISTOURY, in surgery, an instrument for making incisions, of which there are different sorts; some in the form of a lancet, others straight, and fixed in the handle like a knife, others crooked, with a sharp edge on the inside.

BISTRE. A brown pigment, consisting of the finer parts of wood soot, separated from the grosser by washing. The soot of the beech is said to make the best.

BIT, or **BITTS**, in ship-building, the name of two great timbers usually placed abaft the manger in the ship's loof, through which the cross-piece goes; the use of it is to belay the cable thereto while the ship is at anchor.

BIT, or **BITT**, an essential part of a bridle.

There are many kinds of bits; the most simple is a short rod of iron, made rather wider than the horse's mouth, and furnished with a hook or ring at each end, to which the reins are fastened. The snaffle bit has two cross pieces that rest against the lips or sides of the mouth. In the curb bit the mouth piece has usually an arch in the middle to prevent its resting on the tongue. *Bit* also denotes the iron part of a piercer, auger, or similar instruments. *Bit of a key* is the part containing the wards.

BITTER *principle*. The bitter taste of certain vegetables appears to be owing to the presence of a peculiar substance, differing from every other in its chemical properties. It may be extracted from the wood of quassia, the root of gentian, the leaves of the hop, and several other plants, by infusing them for some time in cold water.

BITUMEN, *See* ASPHALTUM.

BIVALVES, one of the three general classes of shell-fish, comprehending all those, the shells of which are composed of two pieces, joined together by a hinge. The Linnæan genera of bivalve shells are mya, solen, tellina, cardium, mactra, donax, venus, spondylus, chama, arca, astrea, anomia, mytillus, and pinna.

BIXA, the *roucou* or *anotto tree*, a genus of the monogynia order, and polyandria class of plants; and in the natural method ranking under the 37th order, columniferæ. The corolla is ten-petaled; the calyx quinquedented; the capsule hispid and bivalved. Of this genus there is but one species known, viz.

Bixa orellana, a native of America. It rises with an upright stem to the height of eight or ten feet, sending out many branches at the top forming a regular bed, with heart-shaped leaves ending in a point, and having long footstalks.

BLACK, something opake and porous, that imbibes the greatest part of the light that falls on it, reflects little or none, and therefore exhibits no colour. Bodies of a black colour are found more inflammable, because the rays of light falling on them are not reflected outwards, but enter the body and are often reflected and refracted within it, till they are stifled and lost.

Black substances are generally found to be lighter than white, being more porous; clothes dyed of this colour wear out faster than those of any other, from the quantity of vitriol necessary to strike the dye.

BLACK, *chalk*. This mineral has a bluish black colour; a slaty texture; soils the fingers, and is meagre to the touch. It contains about 64 silica, 11 allumina, 11 carbon, with a little iron and water. It is found in primitive mountains, and also sometimes near coal formations. It occurs in Caernarvonshire, and in the island of Isla.

BLACK, *Jack*. The miners distinguish blende, or mock lead, by this name. It is an ore of zinc.

BLACK, *German*, or Frankfort black, is produced from the lees of wine, washed in water, then ground with burned ivory, bones or peach stones. It is chiefly used by copper-plate printers for working off their engravings.

BLACK, *ivory*, a substance made from burned

in water, and made into troches for the use of painters, Jewelers, &c. In order to be good it must be tender, friable, and thoroughly ground.

BLACK, *lamp*, the finest kind of this article is produced by collecting the smoke from a lamp with a long wick, which supplies more oil than can be perfectly consumed, or by suffering the flame to play against a metaline cover, which impedes the combustion, not only by conducting off part of the heat, but by obstructing the current of air. Lampblack, however, is prepared in a much cheaper way, for the demands of trade. The dregs which remain after the eliquation of pitch, or else small pieces of fir wood, are burned in furnaces of a peculiar construction, the smoke of which is made to pass through a long horizontal flue, terminating in a close boarded chamber. The roof of this chamber is made of coarse cloth, through which the current of air escapes, while the soot remains behind.

BLACK, *lead*. *See* PLUMBAGO.

BLACKBURNIA, a genus of the tetrandria monogynia class and order. The essential character is, calyx four toothed; pet. 4; anther heart-shaped; germ. conic; stigma simple; berry one-seeded. There is but one species, a native of Norfolk-island.

BLADDER, a thin membranous substance found in several parts of an animal, serving as a receptacle of some juice, or of some liquid excrement, as the urinary bladder, gall bladder &c.

BLADHIA, a genus of the class and order pentandria monogynia. The essential character is, corolla wheel shaped, deciduous; berry containing one seed. There are three species, natives of Japan.

BLÆRIA, in botany, a genus of the tetrandria monogynia class and order of plants. Its characters are; calyx quadripartite, corolla quadrifid, stamina inserted in the receptacle; the fruit a capsule, with four cells, containing many seeds. There are six species.

BLAIN, among farriers, a distemper incident to beasts; being a certain bladder growing on the root of the tongue, against the windpipe, which swells to such a degree as to stop the breath. To cure it, cast the beast, take forth his tongue, and then slitting the bladder, wash it gently with vinegar and a little salt.

BLAKEA, in botany; a genus of the cla and order dodecandria monogynia: with calyx composed of six leaves below, and entire above; six petals, and a six-celled polyspermous capsule. There are two species, very beautiful shrubs, natives of America.

BLANCHING *of copper* is done various ways, so as to make it resemble silver. If it be done for sale, it is felony by 8 and 9 William III. ch. xxvi.

BLANCHING, in coinage, the operation performed on the planchets or pieces of silver, to give them the requisite lustre and brightness. They also blanch pieces of plate, when they would have them continue white, or have only some parts of them burnished.

Blanching, as it is now practised, is performed by heating the pieces on a kind of peel with a wood-fire, in the manner of a reverberatory: so that the flame passes over the peel. The pieces being sufficiently heated and

common salt, and tartar of Montpelier. When they have been well drained of this water in a copper sieve, they throw sand and fresh water over them; and when dry, they are well rubbed with towels.

Among gardeners, blanching signifies an operation by which certain sallads, roots, &c, are rendered whiter than they would otherwise be, which is effected by covering them, as they grow, with earth.

BLASIA, in botany, a genus of the cryptogamia hepaticæ class and order. Male solitary; imbedded in the frond: female no calyx; capsule imbedded in the frond, oblique, one-celled, with a tubular mouth: seeds numerous. There is one species, a native of England.

BLASPHEMY, a term signifying an indignity, or more properly an injury offered to the Supreme Being, by denying what is his due, or by attributing to the creature what is due only to the Creator. Writers on the subject of blasphemy, seem to have overlooked a most important point, viz. that the denial of the sacred writings to be a transcript of the divine mind amounts to blasphemy. Among the Jews blasphemy was punished by stoning the offender to death; this, like all the other parts of the conduct of that remarkable people, had, doubtless, a symbolical signification; and, perhaps, was intended to teach us that the most effectual method of dealing with blasphemers is, to bring to bear upon their ignorant and foolish objections the doctrines of HIM who is emphatically styled, "*the Stone which the builders rejected.*"

BLAST, in a general sense, denotes any violent explosion of air, whether occasioned by gunpowder, or by the action of a pair of bellows

BLAST, a disease in grain and trees, called also a blight: by some supposed to be owing to cold; and by others to the want of a due supply of sap; some attribute it to ascending fumes from the earth, others to sharp winds and frosts succeeding rain.

But what is termed the blight is frequently nothing more than a debility or distemper in the trees themselves.

BLATTA, a genus of hymenopterous insects, well known in England under the names of cockroaches and black beetles. The blatta most abundant in England, came from America or the East. The best method of clearing them is by a tame hedgehog. All the known species of this insect, whether in the larva, pupa, or perfect winged state secrete themselves in the day, and wander about in the night. Naturalists have enumerated no less than 43 species.

BLAZONING, in heraldry, the art of decyphering coats of arms. In blazoning always begin with the field, and next proceed to the charge; and if many things are borne, begin with that which lies immediately on the field. Such terms for the colours must be used as are suited to the rank of the bearer, and all superfluous expressions must be avoided.

BLEACHING, the art of freeing those articles of manufacture which have vegetable substances for their raw material, from the colouring matter with which such substances are naturally combined. Although the art of bleaching must have been known to the world at a very early period, yet it was not till towards the close of the 18th century that it made rapid progress even in Europe. Till about that time the old, tedious process of bleaching remained in use, which has now, almost universally, given way to the new method of bleaching by means of the oxymuriatic acid. This process, which is attended with immense advantage to the manufacturer, was the discovery of the celebrated Scheele, but the application of it to the art of Bleaching justly belongs to Mr. Berthollet. Various inconveniences were found to attend the process of bleaching cloth by subjecting it to the action of the oxygenated muriatic acid, notwithstanding its great superiority to the old method. These led to the addition of an alkali to the acid; but the use of potash or pearlash was attended with a great additional expense, besides having the effect of weakening the power of the acid. Hence it became an object of importance to the manufacturers of this country to substitute a cheaper substance which should have the same effect. Lime was tried at first in an imperfect manner, but at length with such improvements that it is now always used.

An improvement however of still greater importance has been made by Mr. Tennant of Glasgow, for which he obtained a patent. This improvement consists in combining chlorine with pulverulent lime. By this process a bleaching powder is produced, known in commerce by the name of oxymuriate of lime, which is portable to any distance at a small expense. For use, this powder is diffused in water by agitation; the insoluble matter contained in the lime is allowed to subside until the liquor becomes transparent. When drawn off for use it is further diluted with water, before the goods are immersed in it that are to be whitened. This chloride, well prepared and properly applied will not injure the most delicate muslins. It is also used with great effect in the manufacture of paper; in cleaning old books and prints: and in whitening wax. Silk and woollen stuffs being animal substances are bleached by a process peculiar to themselves thus briefly described by Dr. Ure.

"The colouring principle of silk is undoubtedly resinous. Hence Mr. Baume proposed the following process as the best mode of bleaching it. On six pounds of yellow raw silk, disposed in an earthern pot, 43 pounds of alcohol, sp. gr. 0.867 mixed with 12 oz. muriatic acid. sp. gr. 1.100 are to be poured.

After a day's digestion, the liquid passes from a fine green colour to a dusky brown. The silk is then to be drained, and washed with alcohol. A second infusion with the above acidulated alcohol is then made, for four or six days, after which the silk is drained and washed with alcohol. The spirit may be recovered by saturating the mingled acid with alkali or lime, and distilling. Mr. Baume says, that silk may thus be made to rival or surpass in whiteness and lustre, the finest specimens from Nankin. But the ordinary method of bleaching silk is the following: —The silk, being still raw, is put into a bag of thin linen, and thrown into a vessel of boiling river water, in which has been dissolved good Genoa or Toulon soap.

After the silk has boiled two or three hours in that water, the bag being frequently turned,

it is taken out to be beaten, and is then washed in cold water. When it has been thus thoroughly washed and beaten, they wring it slightly, and put it, for the second time, into the boiling vessel, filled with cold water, mixed with soap and a little indigo; which gives it that bluish cast commonly observed in white silk.

When the silk is taken out of this second water, they wring it hard with a wooden peg, to press out all the water and soap; after which they shake it, to untwist it, and separate the threads. Then they suspend it in a kind of stove constructed for that purpose, where they burn sulphur; the vapour of which gives the last degree of whiteness to the silk.

The method of bleaching woollen stuffs.—There are three ways of doing this. The first is with water and soap; the second with the vapour of sulphur; and the third with chalk, indigo, and the vapour of sulphur.

Bleaching with soap and water.—After the stuffs are taken out of the fuller's mill, they are put into soap and water, a little warm, in which they are again worked by the strength of the arms over a wooden bench: this finishes giving them the whitening which the fuller's mill had only begun. When they have been sufficiently worked with the hands, they are washed in clear water and put to dry.

This method of bleaching woollen stuffs is called the natural method.

Bleaching with sulphur.—They begin with washing and cleansing the stuffs thoroughly in river water; then they put them to dry upon poles or perches. When they are half dry, they stretch them out in a very close stove, in which they burn sulphur; the vapour of which diffusing itself, adheres by degrees to the whole stuff, and gives it a fine whitening: this is commonly called Bleaching by the flower, or bleaching of Paris, because they use this method in that city more than any where else.

BLECHNUM, in botany, a genus of plants of the class of the cryptogamia filices; the fructifications of which are disposed in two parallel lines, approaching to the rib of the frond. There are six species, all foreign plants.

BLENNIUS, the BLENNY, a genus of fishes belonging to the order of jugulares; the characters of which are: the head slants or declines to one side, there are six rays in the membrane of the gills; the body tapers towards the tail; the belly fins have only two blunt bones: and the tail fin is distinct.

BLIGHT. See BLAST.

BLINDNESS, signifies a total privation of sight, arising from some obstruction of the organs of sight, or from a total deprivation of them.

It is a very remarkable circumstance that persons who are either born blind, or who lose their sight at an early period, generally possess what amounts to a compensation for the loss of sight. Numerous proofs of this are on record: the case of Professor Saunderson is well know; and the names of Blacklock, Milton, Moyes, and others bear evidence to the fact. This is not the place to enter on a discussion of the subject; but we cannot help suggesting the idea that the cases above mentioned appear to furnish a powerful argument against the correctness of the system of some modern zoologists, who affirm that mind is no more than an effect of the organization of matter. Have we not here a satisfactory proof of the existence of an interior sight, after the organ, by disease, has ceased to be of service to it.

Various plans have been devised for the instruction of the blind, some of which have proved highly useful: the *Essay on the Education of the Blind* by Mr. Haüy does great honour to the author; it contains a detail of a great variety of expedients by which the blind may be successfully instructed in many of the mechanic arts, as well as in music, arithmetic, geography, &c., and may even be taught to read, write, and print.

BLINDS, in the art of war, a sort of defence made of oziers, or branches interwoven and laid across between two rows of stakes, used at the heads of trenches, to shelter the workmen, and prevent their being overlooked by the enemy.

BLISTER, in medicine, a thin bladder containing a watery humour, whether occasioned by burns, and the like accidents, or by vesicatories laid on different parts of the body for that purpose.

BLITUM, the blite, or *strawberry spinach*, a genus of the digynia order and monandria class of plants, and of the 12th natural holoraceæ. There are 4 species, 1. Blitum capitatum, which is a native of Spain and Portugal. It is an annual plant. The fruit is full of a purple juice, but not eatable, 2. Blitum Tartaricum, is a native of Tartary. It grows nearly three feet in height: but the flowers and fruit are smaller than those of the capitatum. 3. Blitum virgatum is a native of France and Italy. It is smaller than either of the preceding. 4. Blitum chenopodiodes is a low plant and a native of Tartary. All these species are propagated by seeds.

BLOCKS, on ship-board, is the usual name for what we call pulleys at land. They are thick pieces of wood, some with three, four, or five shivers in them, through which all the running ropes run. Blocks, whether single or double, are distinguished and called by the names of the ropes they carry, and the uses they serve for.

Blocks now used in the navy are made in the Portsmouth yard, by means of machinery, which has lately been erected for the purpose, and which performs the several operations from the rough timber to the perfect block in the completest manner possible.

BLOCKADE, in the art of war, the blocking up a place by posting troops at all the avenues leading to it, to keep supplies of men and provisions from getting into it; and by these means proposing to starve it out without making any regular attacks.

BLOOD, SANGUIS, a red liquor circulating through the arteries, veins, and other vessels of animal bodies; and serving for the support of life, and nourishment of all their parts. See ANATOMY, and PHYSIOLOGY.

BLOW-PIPE, a hollow tube, used by chemists, enamellers, glass-makers, jewellers, &c. It is a wind instrument for the purpose of increasing the heat of a candle or lamp.

Great and important improvements have recently been made in the construction of the blow-pipe. Instead of the simple tube of brass

through which the breath of the operator was impelled, we have now the self-acting blow-pipe, variously constructed; but without enumerating the varieties of this instrument it may be sufficient to state that, for the general purposes of the mineralogist, nothing can exceed the powers of that which is sold by the philosophical instrument makers, under the name of the oxy-hydrogen blow-pipe, charged with one part of oxygen, and two of hydrogen, by means of a condensing syringe; and which is capable of obtaining the highest temperatures; and of fusing the most refractory substances submitted to its action.

BLOWING *machine*, an engine for forcing air with great velocity into a furnace to increase the combustion; blowing-engines are now used in all the practical operations of metallurgy.

BLOWING *of glass*, one of the methods of forming the divers kinds of works in the glass manufacture.

It is performed by dipping the point of an iron blowing-pipe in the melted glass, and blowing through it with the mouth.

BLUE, otherwise called azure, is one of the primitive colours of the rays of light.

Blue, *painter's*, is made different according to the different kinds of painting.

In limning, fresco, and miniature, they use indifferently ultra-marine, blue ashes, and smalt: these are their natural blues, excepting the last, which is partly natural and partly artificial.

BLUING *of iron*, is a method of beautifying that metal, which is thus effected. When the surface is perfectly clean, the metal is subjected to the heat of a clear charcoal fire; and, as the heat increases, it becomes first of a light, then of a deep straw colour, and lastly of a fine blue.

BOA, a genus of serpents. See Serpent.

BOAR. See Sus.

BOARD, among seamen, signifies to go into the ship. Board and board, is when two ships come so near as to touch one another, or when they lie side by side. To make a board, is to turn to windward. To board it up, is to beat it up sometimes upon one tack, and sometimes upon another. The weather board is that side of the ship which is to windward.

BOAT, is a small open vessel worked by oars or sails. The construction and names of boats are different, according to the purposes for which they are intended. The boats or wherries plying on the Thames about London are either scullers, wrought by a single person with oars; or boats, wrought by two persons each with an oar.

Boat, *life*, a boat invented by Mr. Henry Greathead, of South Shields, for the purpose of preserving the lives of shipwrecked persons.

For this invention, Mr. Greathead received a gold medal and fifty guineas from the Society of Arts, in 1802; and a Parliamentary reward of 1200 pounds, besides further remuneration from the Trinity House, and from Lloyd's Coffee House. The boat is thirty feet in length, and ten in breadth, and its depth three feet. Captain Manby, of the Royal Navy, has suggested a plan by which, at a trifling expense, any boat may be easily converted into a life boat. This is done by connecting with the boat a number of empty casks, which give it such a degree of buoyancy, that when filled with water, it may be rowed with ease, and perform any service required.

BOATSWAIN, a ship-officer, to whom is committed the charge of all the tacklings, sails and rigging, ropes, cables, anchors, flags, pendants, &c. He is also to take care of the long-boat and its furniture, and to steer her either by himself or his mate. He calls out the several gangs and companies aboard, to the due execution of their watches, works, spells, &c.

BOBBIN, a small piece of wood turned in the form of a cylinder, with a little border jutting out at each end, bored through to receive a small iron pivot.

BOCCONIA, in botany, a genus of the monogynia order, and dodecandria class of plants, in the natural method belonging to the 27th order, rhœadeæ. The only species is the bocconia frutescens, which is a native of America and the West Indies. It grows to the height of twelve feet, and the trunk is covered with a white bark. At the top it divides into several branches on which the leaves are situated alternately. The plant abounds with an acrid juice, used by the inhabitants to remove warts and spots from the eyes.

BODY, in physics, an extended solid substance, of itself utterly passive and inactive, indifferent either to motion or rest; but capable of any sort of motion, and all figures and forms.

Body, in geometry. The regular bodies, or those which have all their angles and sides similar and equal, are five, viz. tetrahedron, octahedron, dodecahedron, icosahedron, and the cube. See Geometry.

Bodies, *descent of*, See Mechanics.

BOEHMERIA, a genus of the monœcia tetrandria class and order.

There are 5 species, natives of America and the West Indies.

BOERHAAVIA, a genus of the monogynia order, and monandria class of plants. There are 7 species, all natives of the Indies.

BOILING or *ebullition*, is the agitation of a fluid body, arising from the application of heat. All fluidity is the effect of a quantity of caloric, or the matter of heat, absorbed by a body in passing from a solid to a fluid state, and boiling is the act of a body from a fluid state, to that of vapour, by a further absorption of the caloric. If the heat is applied to the bottom of the vessel, after the whole liquid has acquired a certain temperature, those particles next the bottom become elastic, and ascend as they are formed through the liquid like air-bubbles, and throw the whole into violent agitation. The liquid is then said to boil. Every liquid has a fixed point, at which boiling commences, and this is called the boiling point. Thus water begins to boil when heated to 212 degrees. After a liquid has begun to boil, it will not become hotter, however much the fire may be increased.

It was observed, however, by Dr. Hooke, that a stronger heat makes all liquids boil more rapidly, though it does not increase their temperature.

BOLE. A massive mineral, having a perfectly conchoidal fracture a glimmering internal lustre, and a shining streak. Its colours are yellow-red, and brownish-black, whence it is called mountain soap. It is trans-

lucent or opaque. Soft, so as to be easily cut, and to yield to the nail. It adheres to the tongue, has a greasy feel, and falls to pieces in water. Sp. grav. 1. 4 to 2. It may be polished. If it be immersed in water after it is dried, it falls asunder with a crackling noise. It occurs in wacke and basalt, in Silesia, Hessia, and Sienna in Italy, and also in the cliffs of the Giant's Causeway in Ireland.

BOLETUS, in botany, so called from its globular form, characterised by Linnæus as a horizontal fungus; porous, with lobes underneath. In the fourteenth edition of the "Systema Naturæ, only twenty-one species are recited, eleven of which are parasitical and stemless, the rest are stipitated. From B. igniarius is prepared the amadou, commonly used on the Continent for tinder, to receive the spark struck from the steel by the flint, and the agaric for stopping hæmorrhages in amputations, &c.

BOLOGNIAN *Stone.* Lemery reports, than an Italian shoemaker, named Vincenzo Casciarolo, first discovered the phosphoric property of the Bolognian stone. It is the ponderous spar, or native sulphate of barytes.

If it be first heated to ignition, then finely powdered, and made into a paste with mucilage; and this paste divided into pieces a quarter of an inch thick, and dried in a moderate heat, be exposed to the heat of a wind furnace, by placing them loose in the midst of the charcoal; a pyrophorus will be obtained, which, after a few minutes' exposure to the sun's rays, will give light enough in the dark to render the figures on the dial-plate of a watch visible.

BOMB, in military affairs, a globe or shell of cast iron, having a vent to receive a wooden fuse. The shell being filled with powder the fuse is fastened with a cement within an inch of the head. The tube is filled with a combustible matter, which burns when the bomb is fired off, and at last communicating with the gunpowder, the bomb bursts with great violence.

BOMBARDMENT, the act of assaulting a fortified place, by throwing shells into it to destroy the houses, magazines, &c. The mortars for firing bombs are usually fixed at an elevation of forty-five degrees, by which means the shell describes a curve called the military projectile; but the elevation must necessarily vary according to distance and other circumstances.

BOMBAX, in botany, the silk cotton-tree; a genus of the polyandria order, and monodelphia class of plants; and in the natural method ranking under the 37th order, columniferæ. The species are:

1. Bombax ceiba, with a prickly stalk.

2. Bombax heptaphyllum, with leaves cut into seven parts. The cotton is of a fine purple colour, but the size of the tree is not particularly mentioned by botanical writers.

3 Bombax pentandrum, with a smooth stalk. This and the ceiba grow naturally in both the Indies, where they arrive at a great magnitude being some of the largest trees in those parts. Bosman says, he has seen in Guinea trees of this kind so widely diffused, that 20,000 armed men might stand under the branches of one. They generally grow with straight stems.

BOMB *ketch*, a small vessel built and strengthened with large beams for the use of mortars at sea.

A bomb ketch is generally from 60 to 70 feet long, and draws eight or nine feet of water.

BOMBIC *acid*, in chemistry, an acid found in a cavity near the anus of the silk-worm. It is of a yellowish colour.

BOMBAX. See PHALÆNA.

BOND. A bond is a deed whereby the person bound, binds himself, his heirs, executors, and administrators, to pay a certain sum of money, or do some other act against a certain day.

If the condition of a bond is impossible at the time of making it, if it is to do a thing contrary to law, the obligation is void. The bond of a feme converte is void, as is that of an infant. If a person is in confinement, and, during such restraint, enters into a bond to a person who causes the restraint, the same may be avoided for duress of imprisonment.

A bond, *post obit*, is one that becomes payable after the death of some person therein specified.

BONE, is the most solid part of animal substances; it is white, hard, brittle and forms the principal support of the whole fabric. The bones of men and quadrupeds owe their firmness and solidity to a considerable portion of the phosphate of lime which they contain. These when rasped small, and boiled in water afford gelatinous matter, and a portion of fat, or oil which occupied their interstices. Bones are of extensive use in the arts. In their natural state, or dyed of various colours, they are made into handles of knives and forks, and numerous articles of turnery.

BONES, fossile or petrified, are those found in the earth, frequently at great depths in all strata, even in the bodies of stones and rocks. Some of these bones are of a huge size, usually supposed to be the bones of giants, but more truly of elephants or hippopotami, others smaller, as the vertebræ, teeth, and the like.

BONNET, in fortification, a small work, consisting of two faces, having only a parapet with two rows of palisadoes, of about ten or twelve feet distance. It is generally raised before the salient angle of the counterscarp, and has a communication with the covered way by a trench cut through the glacis, and palisadoes on each side.

BOOK, is a general name given to a work compesed for the purpose of comunicating the knowledge of its author on the subject or subjects on which it treats. The etymology of the word book indicates that books were originally written on vegetable substances: Such as the bark of trees, the leaves of plants, or on tablets of wood, which practice, indeed, is still continued in those nations that have made but little progress in refinement. The works of Hesiod were written on tables of lead, and the laws of Solon were cut on planks of wood.

There is at present in France a book that is neither written nor printed, and bears the following title. *Liber Passionis Domini Nostri Jesu Christi cum Figuris et Characteribus nulla Materia compositis.*

This work consists of the finest vellum: the letters are all cut out of each folio; and, being interleaved with blue paper, the reading is as distinct as any printing.

BOOK *binding*, is the art of sewing together the sheets of a book, and securing them with a back and side boards. The leaves being folded in the order of the signatures, are beaten on a stone with a hammer to make them smooth. they are then put into a press and sewed on

bands, after which the backs are glued and the bands opened and scraped for the better fixing the pasteboards; the back is turned with a hammer, and the book fixed in a press between two boards, in order to make a groove for the pasteboard; holes are then made for fixing them to the book, which is pressed a third time. Then the book is put into the cutting press betwixt two boards, one lying even with the press for the knife to run upon, the other above for the knife to run against; after which the pasteboards are squared. The next operation is the sprinkling the leaves, which is done by dipping a brush in vermilion and sap green, holding the brush in one hand and spreading the hair with the other. The covers being moistened in water are cut to the size of the book, then smeared with paste and afterwards stretched over the pasteboard on the outside, and doubled within, after having taken off the four angles and indented and platted the cover at the head-band: which done the book is covered and bound between two bands and set to dry. It is afterwards washed with paste and water, and then sprinkled with a brush; unless it is to be marbled when the spots are made larger by the addition of vitriol. After this the book is glazed with the white of an egg and lastly polished with a hot iron. The letters and ornaments are made with gilding tools or brass cylinders rolled along by a handle. To apply the gold the leather is glazed with a liquor made of whites of eggs diluted with water, and, when nearly dry, the gold leaf is laid on and applied with tools heated first in a charcoal fire.

BOOK *keeping*, an art teaching how to record and dispose the accounts of business, so that the true state of every part and of the whole may be distinctly known.

Merchants' books are kept either by single, or double entry. Those who keep them by the former method have occasion for only a journal or day-book, and a ledger or post-book; the former to enter all the articles as they occur in the course of business, and the other to draw out the accounts of all debtors and creditors on the journal. This method is only proper for traders who have but very little business; but wholesale dealers, who keep their books according to the double entry, or Italian method, require several other books.

The most considerable books according to the method of double entry, are, the waste-book, the journal, and the ledger; but besides these three, which are absolutely necessary, there are several others, to the number of thirteen, or even more, called subservient or auxiliary books, which are used in proportion to the business a man has or to the nature of the business a man carries on. These books are the cash-book, the debt-book, the book of numeros, the book of invoices, the book of accounts current, the book of commissions, orders, or advices, &c.

The *waste-book* is a register, containing an inventory of a merchant's effects and debts, with a distinct record of all his dealings.

The waste-book opens with the inventory, which consists of two parts; first, the effects, that is, the money a merchant has by him, the goods in hand, his part of ships, houses, farms, &c. with the debts due to him; the second part of the inventory is the debts due by him: the difference between which, and the effects, is what is called neat stock.

After the inventory is fairly related in the waste-book, the transactions of trade come next to be entered down; which is a daily task to be performed as they occur. The narrative ought to exhibit transactions with all the circumstances necessary to be known, and no more. It should contain the names of persons with whom the merchant deals upon trust, the conditions of bargains, the terms of payment, the quantity, quality, and prices of goods, with every thing that serves to make the record distinct, and nothing else. The waste-book, if no subsidiary books are kept, should contain a record of all the merchant's transactions and dealings in a way of trade; and that not only of such as are properly mercantile, but of every occurrence that affects his stock, so as to impair or increase it.

The *journal*, or *day-book*, is the book wherein the transactions recorded in the waste-book are prepared to be carried to the ledger, by having their proper debtors and creditors ascertained and pointed out: whence it may be observed, that the great design of it is to prevent errors in the ledger. After the ledger is filled up, the journal facilitates the work required in revising and correcting it; for first the waste-book and journal are compared, and then the journal and ledger; whereas to revise the ledger immediately from the waste book, would be a matter of no less difficulty, than to form it without the help of a journal: lastly, the journal is designed as a fair record of a merchant's business; for neither of the other two books can serve this purpose; not the ledger, by reason of the order that obtains in it, and also on account of its brevity, being little more than a large index: nor can the waste-book answer this design, as it can neither be fair nor uniform, nor very accurate, being commonly written by different hands, and in time of business.

In the journal, persons and things are charged debtors to other persons and things as creditors; and in this it agrees with the ledger, where the same style is used, but differs from it as to forms and order; so that it agrees with the waste-book in those very things where it differs from the ledger.

It may be observed, that every case or example of the waste-book, when entered into the journal, is called a journal post, or entrance.

Accounts in the ledger consist of two parts, which in their own nature are directly opposed to, and the reverse of one another, and are therefore set fronting one another, and on opposite sides of the same folio.

The two parts in any case in the waste-book, when posted to the journal, are denominated the one the debtor, the other the creditor of that post; and when carried from thence to the ledger, the debtor, or debtor part, is entered upon the left side (hence called the debtor side) of its own account, where it is charged debtor to the creditor part: again, the creditor, or creditor part, is posted to the right side, or creditor side of its account, and made creditor by the debtor part. Hence Italian book-keeping is said to be a method of keeping accounts by double entry, because every single case of the waste-book requires at least

two entrances in the ledger, *viz.* one for the debtor, and another for the creditor.

Of the ledger. The ledger is the principal book wherein all the several articles of each particular account, that lie scattered in other books, according to their dates, are collected, and placed together in spaces allotted for them, in such a manner, that the opposite parts of every account are directly set fronting one another, on opposite sides of the same folio.

The folios are divided into spaces, on the head of which are written the titles of the accounts, marked Dr. on the left hand page, and Cr. on the right: below which stand the articles, with the word *To* prefixed on the Dr. side, and the word *By* on the Cr. side; and on the margin are recorded the dates of the articles, in two small columns. The money columns are the same as in other books: before them stand the folio column, which contains figures, directing to the folio where the corresponding ledger-entrance of each article is made; for every thing is twice entered in the ledger. Besides these columns, there must be kept in all accounts, where number, measure, weight, or distinction of coins is considered, inner columns to insert the quantity; and for the ready finding any account in the ledger, it has an alphabet or index, wherein are written the titles of all accounts, with the number of the folio where they stand.

Rules for filling the ledger from the journal. 1. Turn to the index, and see whether the Dr. of the journal post, to be transported, is written there: if not, insert it under its proper letter, with the number of the folio to which it is to be carried.

2. Having distinguished the Dr. and the Cr. sides, complete the entry in one line, carrying the sum to the money columns; and inserting the quantity, if it is an account of goods, &c. in the inner columns, and the referring figure in the folio column.

3. Turn next to the creditor of the journal-post, and so proceed in the same manner with it, both in the index and ledger; with this difference only, that the entry is to be made on the Cr. side, and the word By prefixed to it.

4. The post being thus entered in the ledger, return to the journal, and on the margin mark the folios of accounts, with the folios of the Dr. above, and the Cr. below, and a small line between them, thus $\frac{1}{2}$. These marginal numbers of the journal are a kind of index to the ledger.

5. In opening the accounts in the ledger, follow the order of the journal; beginning with the first journal-post, allow the first space for the Dr. the next for the Cr. the third for the Dr. of the following post, and so on till the whole journal be transported.

Cash Book. This is the most important of the auxiliary books. It is so called, because it contains, in debtor and creditor, all the cash that comes in, and goes out of a merchant's stock; the receipts on the debtor side; the person of whom it was received, on what, and on whose account.

Book of debts or payments, is a book in which is written down the day on which all sums become due, either to be received or paid, by bills of exchange, notes of hand, merchandizes bought or sold, or otherwise Other auxiliary books besides these are kept according to the nature and extent of the concern.

BOOKSELLER, one who trades in books, whether he prints them himself, or gives them to be printed by orders.

Booksellers are in many places ranked among the members of universities, and entitled to the privilege of students, as at Tubingen, Saltsburg, and Paris, where they have always been distinguished from the vulgar and mechanical traders, and exempted from divers taxes and impositions laid upon other companies.

BOOM, in the sea-language, a long piece of timber with which the clue of the studding-sail is spread out; and sometimes the boom is used to spread or boom out the clew of the mainmast.

The different kinds of booms have different names according to the purposes for which they are intended.

BOOM denotes also a cable stretched athwart the mouth of a river or harbour; with yards, top-masts, battling, or spars of wood lashed to it, to prevent an enemy's coming in.

BOOTES, a constellation of the northern hemisphere, consisting of 23 stars according to Ptolemy's catalogue, of 28 in Tycho's, of 34 in Bayer's, of 52 in Hevelius's, and of 45 in Mr. Flamsteed's catalogue.

BORACIC *acid*. See ACID (BORACIC.) This acid has been found native on the edge of hot springs, near Sapo in the territory of Florence; also attached to specimens from the Lipari Islands, and from Monte Rotondo, to the west of Sienna. It is in small early scales, and also massive, fusing at the flame of a candle into a glassy globule. It consists, by Klaproth's analysis, of 86 boracic acid, 11 ferruginous sulphate of manganese, and 3 sulphate of lime.

BORAGO, in botany, a genus of the pentandria monogynia class and order, the flower of which consists of a single petal of the length of the cup, and is divided into five segments: there is no pericarpium, but the cup grows larger and is inflated, and contains four roundish seeds. There are five species.

BORASSUS, a genus of plants, of the dioecia hexandria class and order. The male flower is called ampana, and the female catimpana, on account of their different appearance. There is only one species, a native of Ceylon.

BORAX, or *sub-borate of soda*, is a substance dug out of wells in Thibet, and imported into England from India. It is in whitish crystals, has an alkaline taste, and turns vegetable blues green. It is soluble in water, twenty times its weight of water; it is much used as a flux in soldering metals, but is little used in medicine. Its specific gravity is 1.740. According to Bergman it contains 39 parts of boracic acid, 17 of soda, and 44 of water.

BORDURE, in heraldry, a cutting off from within the escutcheon all round it about $\frac{1}{5}$th of the field, serving as a difference in a coat of arms, to distinguish families of the same name, or persons bearing the same coat.

BORE, among engineers, denotes the diameter of the barrel of a gun or cannon, or rather its whole cavity.

BORE, *square*, among mechanics, a square piece of well tempered steel, fitted into a

handle, serving to widen holes, and make them perfectly round.

BORING, is the method of piercing the earth in search of minerals, &c. The scooping irons made use of for this purpose are drawn back at proper times and the samples of earth and mineral matters they bring up are examined to know whether it is worth while to open a mine in the place.

BOROUGH, or BURGH, a corporation or town which is not a city. The word in its original signification meant a company consisting of ten families, which were bound together as each other's pledge.

The name is now particularly appropriated to such towns or villages as send burgesses or representatives to parliament.

BOROUGHS, *Royal*, in Scotland, are corporations made for the advantage of trade, by charters granted by several of their kings, having the privilege of sending commissioners to represent them in parliament, besides other peculiar immunities. They form a body of themselves, and send commissioners each to an annual convention at Edinburgh, to consult the benefit of trade and their general interest.

BOROUGH-*English*, a customary descent of lands or tenements, in certain places, by which they descend to the youngest instead of the eldest son; or, if the owner has no issue, to the younger instead of the elder brother.

BOS, in zoology, *the ox*, a genus of quadrupeds of the order pecora. The generic character is, horns concave, turned outwards, lunated, smooth; front teeth, eight in the lower jaw, canine teeth, none.

1st. The bison, from which the several races of common cattle have been gradually derived, is found wild in many countries; inhabiting woody regions, and arriving at a size far larger than that of the domestic or cultivated animal. In its native state, the bison is distinguished, not only by his size, but by the depth and shagginess of his hair; which, about the head, neck, and shoulders, is sometimes of such length as almost to touch the ground. His colour is a blackish brown, his eyes large and fierce, his limbs extremely strong, and his whole aspect savage and gloomy.

2nd. Common ox. This is, in reality, the bison reduced to a domestic state; in which it runs into as many varieties as the sheep.

The British breed of horned cattle has been so much improved by a foreign mixture, that it is difficult to point out the original kind.

3d. Indian ox. This variety is found in many parts of India, also in the Indian and African islands, and particularly in Madagascar. It is of a reddish colour, of a very large size, and is distinguished by a very large protuberance above the shoulders.

4th Zebu. This variety resembles the preceding, but is extremely small. In colour it differs like the common cattle; being either grey, brown, white, &c. or variously spotted.

5th. Loose-horned ox. This is said to be found in Abyssinia and Madagascar, and to be distinguished by pendulous ears, and horns attached only to the skin, so as to hang down on each side.

6. Boury. Of the size of a camel, and of a snowy-whiteness, with a protuberance on the back. Native of Madagascar, and some other islands, called by the name of Boury.

7. Tinian ox. Of a white colour, with black ears. Inhabits the island of Tinian.

II. Bos *Arnee*, (ox with upright lunated horns, flat and wrinkled on their upper surface.)

This is an Indian species, remarkable for its vast horns, which are sometimes seen in museums.

III. Bos *Babylus*, or buffalo ox, with horns lying backwards, turning inwards, and flat on the fore part.

In its general appearance, the buffalo is nearly allied to the common ox. It differs, however, in the form of its horns, and in some parts of its internal structure, and is rather superior in size to the common ox. The general or prevailing colour is blackish, except the hair on the top of the forehead, and that at the tip of the tail, which is of a yellowish white.

As the buffalo in his domesticated state is larger and stronger than the ox, he is employed with advantage in different kinds of labour. Buffaloes are made to draw heavy loads, and are commonly directed and restrained by means of a ring passed through the nose.

The buffalo, like other animals of this genus, admits of varieties. Of these the most remarkable is the small naked Indian buffalo of Mr. Pennant.

IV. Bos *Moschatus*, or musk ox, having very long pendant hair, and horns bending inwards and downwards, and outwards at the tips.

It is a native of North America, where it appears to be a very local animal.

It is but of small size, being rather lower than the deer, but larger or thicker in body. The hair, in the male, is of a dusky red colour, extremely fine, and so long as to trail on the ground. Beneath the hair, is an extremely fine wool, which is said to be more beautiful than silk when manufactured into stockings and other articles. The horns are closely united at the base, bending inwards, but turning outwards towards the tips, which are very sharp.

V. Bos *Grunniens*, or yak, is about the height of an English bull, which he resembles in the general figure of the body, head, and legs; it is covered with a thick coat of long hair.

They are a very valuable property to the Tartars, who live in tents, and tend them from place to place: they at the same time afford their herdsmen an easy mode of conveyance, a good covering, and wholesome subsistence. Tents and ropes are manufactured of their hair: and amongst the humbler ranks of herdsmen, caps and jackets are made of their skins.

VI. Bos *Caffer*, or Cape ox, having large horns, inhabits the interior parts of Africa, north of the Cape of Good Hope, and is greatly superior in size to the largest English ox. It is of a very strong and muscular form, with a fierce and malevolent aspect. Its colour is a deep brown.

It is said to strip off the skin of such animals as it kills, by licking them with its rough tongue.

BOSEA, GOLDEN-ROD TREE: a genus of the digynia order, and pentandria class of plants; and in the natural method ranking under the 53d order, scabridæ. The calyx is pentaphyllous; there is no corolla, and the berry is monospermous. Of this genus there is but one species, viz.

Bosea yervamora. It is a native of the Canary and Caribbee islands, and is a strong woody shrub.

BOTANY, may be defined the science which teaches the knowledge of the vegetable kingdom. The word is derived from the Greek βοτανη, an herb; and this again may easily be traced to its primitive, βοω, or βοσκω, to feed: an apt derivation, since plants have ever been regarded as the food of a large portion of animals. The study of botany, then may be said to include—the practical discrimination, methodical arrangement, and systematical momenclature of vegetables.

The following article will serve to give the student a general idea of the subject, and prepare him for consulting with advantage the excellent work of Dr. Smith on Physiological and Systematical Botany, with other well known and approved productions on the same subject.

In describing the characters of plants, we shall treat of their roots, buds, trunk, leaves, props, inflorescence, fructification, and classification.

I. ROOTS are necessary to plants, to fix and hold them in the earth, from which they imbibe nourishment. Roots are either *annual*, or living for one season, as in barley; *biennial*, which survive one winter, and after perfecting their seed, perish at the end of the following summer, as wheat: or *perennial*, which remain and produce blossoms for an indefinite number of years, as those of trees and shrubs in general. The root consists of two parts, the *caudex* and the *radicula*. The *caudex* or stump is the body or knob of the root, from which the trunk and branches ascend, and the fibrous roots descend. The *radicula* is the fibrous part of the root branching from the *caudex*. Roots are: 1. *Fibrous*, or consisting entirely of fibres, as in many grasses and herbaceous plants. 2. *Creeping*, or having a subterraneous stem, spreading horizontally in the ground, throwing out numerous fibres, as in mint and couch-grass. 3. *Spindle-shaped*, as in the radish and carrot, which produce numerous fibres for the absorption of nutriment. 4. *Stumped*, or apparently bitten off, as in the primrose. 5. *Tuberous* or knobbed, as in the potatoe, which consists of fleshy knobs, connected by common stalks or fibres. 6 *Bulbous*, as in the crocus. 7. *Granulated*, having a cluster of little bulbs or scale connected by a common fibre, as in the saxifrage.

II. BUDS. These are, in most instances, guarded by scales, and furnished with gum or wooliness, as an additional defence. Buds are various in their forms, but very uniform in the same species, or even genus. They enfold the embryo plant.

III. TRUNK. The trunk of trees includes the stems or stalks, which are of seven kinds. The stem, as it advances in growth, is either able to support itself, or twines round other bodies. It is either *simple* as in the lily; or *branched* as in other plants. The parts are: 1. *Caulis*, the stem which bears both leaves and flowers, as the trunks and branches of all trees and shrubs, as well as of many herbaceous plants. 2. *Culmus*, a straw or culm, the peculiar stem of grasses, rushes, and similar plants. 3. *Scapus* or stalk, springs immediately from the root, bearing flowers and fruit, but not leaves, as in the primrose or cowslip. 4. *Pedunculus*, the flower-stalk, springs from the stem or branches, bearing flowers and fruit, but not leaves. 5. *Petiolus*, the foot-stalk, is applied exclusively to the stalk of a leaf.

IV. LEAVES. These are generally so formed as to present a large surface to the atmosphere. When they are of any other hue than green, they are said, in botanical language, to be *coloured*. The internal surface of a leaf is highly vascular and pulpy, and is clothed with a cuticle very various in different plants; but its pores are always so constructed as to admit of the requisite evaporation or absorption of *moisture*, as well as to admit and give out air. *Light* also acts through this cuticle, in a different manner. The effect of *moisture* must have been observed by every one. By absorption from the atmosphere, the leaves are refreshed; but by evaporation, especially when separated from their stalks, they soon fade and wither. The nutritious juices, imbibed from the earth and become *sap*, are carried by appropriate vessels into the substance of the leaves, and these juices are *returned* from each leaf, not into the wood again, but into the bark. The sap is carried into the leaves for the purpose of being acted upon by *air* and *light*, with the assistance of heat and moisture. By all these agents, a most material change is wrought in the component parts of the sap, according to the nature of the secretions elaborated, whether resinous, oily, mucilaginous, saccharine, bitter, acrid, or alkaline.

The *green* colour of the leaves is owing to the action of light, but they are subject to a disease by which they become partially spotted or streaked, and in this state are said to be variegated. The irritable nature of some leaves is very extraordinary. The *mimosa pudica* or sensitive plant, common in our hot-houses, when touched by any extraneous body, folds up its leaves, one after another, and the foot stalks droop as if dying.

V. Props or fulcra. These are: 1. *Stipula*, a leafy appendage to the true leaves, or to their stalks, for the most part in pairs. 2. *Bractia*, a leafy appendage to the flower, or to its stalk. 3. *Spina*, a thorn proceeding from the wood itself as in the wild pear tree, which loses its thorns by cultivation. 4. *Aculeus*, a prickle, proceeding from the bark only; as in the rose and bramble. 5. *Cirrus*, a tendril or clasper, is a support for weak stems by which they are enabled to climb rocks, or the trunks of lofty trees. 6. *Glandula*, a gland, is a small tumour, secreting a sweet, resinous, fragrant liquor, as on the calyx or cup of the moss-rose, and the foot stalks of passion flowers. 7. *Pilus*, a hair, which includes all the various kinds of pubescence · bristles, wool, &c. some of which discharge a poison, as in the nettle causing

great irritation wherever they are touched, so that their points may wound the skin.

VI. INFLORESCENCE, or the different kinds or modes of flowering, are, 1. *Verticillus*, a whorl, in which the flowers surround the stem in a garland or ring, as in the mints, dead-nettles, &c. 2. *Racunus*, a cluster, bears several flowers, each on its own stalk, like a bunch of currants. 3. *Spika*, a spike, is composed of numerous crowded flowers, ranged along an upright, common stalk, expanding progressively, as in wheat and barley. 4. *Corymbus*, a corymb, is a flat-topped spike as in the cabbage and wall-flower. 5. *Fasciculus*, a close bundle of flowers, as in the sweet william. 6. *Capitulum*, a head or tuft, as in the globe-amaranthus and thrift. 7. *Umbella*, an umbel consists of several stalks, called rays, spreading like an umbrella, as in parsley, carrot, and hemlock. 8. *Cyma*, a cyme, or stalks springing from a common centre, and afterwards irregularly subdivided, as in the laurustinus, and elder. 9. *Paniculus*, a panicle, a loose subdivided bunch of flowers, as in the oat. 10. *Thyrsus*, a bunch, is a very dense panicle inclining to an oval figure, as in the lilac.

VII. *Fructification.* Under this term are comprehended not only the parts of the fruit, but also those of the flower, which last are necessary for bringing the former to perfection. Fructification consists of seven parts, two only of which are *essential*, viz. *stamen* and *pistil*, since without them no plant can produce seeds. 1. *Calyx*, a flower cup, or external covering of the flower; to this belong the perianthium; involucrum; amentum, or cat-kin; spatha, or sheath; gluma, or husk; perichætium or scaly sheath; and volva, the wrapper. 2. *Corolla*, or little crown, is situated within the calyx, and consists in general of the coloured leaves of a flower,—the petalum, or petal, and the nectarium, or nectary, belonging to the corolla. 3. *Stamina*, the stamens, are various in number, in different flowers, and are situated within the corolla. The stamen consists of a filamentum, or filament, and the anthera, or anther. The cells of the latter contain the pollen or fecundating dust. 4. *Pistilla*, the pistils stand in the centre of the circle formed by the stamens, and consist of the germen or rudiments of the future fruit or seed; the style, which elevates the stigma; and the stigma which is destined to receive the pollen. 5. *Pericarpium*, the seed vessel, is formed from the germen enlarged, and is of the following kinds: a capsular or capsule; siliqua, or pod; legumen, or legume, the fruit of the pea-kind; drupa, stone-fruit; pomum, an apple, bacca, a berry; and strobilus, a cone. 6. *Semina*, the seeds, are composed of the embryo or germ, called by Linnæus, corculum, or little heart; the cotyledones, or seed-lobes almost universally two in number; albumen, the white; vitellus, the yolk; testa, the skin; and bilum, the scar.

Seeds are often accompanied by appendages or accessory parts; as, pellicula, the pellicle; arillus, the tunic; pappus, the seed-down; cauda, a tail; rostrum, a beak. To which may be added various spines, hooks, scales, and crests, generally serving to attach such seeds as are furnished with them, to the rough coats of animals, and thus promote their dispersion. 7. *Receptaculum*, the receptacle, is the base which receives the other parts of the fructification. It is *proper* when it supports the parts of a single fructification only; when it is a base to which only the parts of the flower are joined, and not the germen, it is called a receptacle of the flower; in this case the germen being placed below the receptacle of the flower, has a base of its own, which is called the receptacle of the fruit, and it is termed a receptacle of the seeds, when it is a base to which the seeds are fastened within the pericarpium. It is called *common* when it supports a head of flowers.

VIII. *Classification.* The system of Linnæus, now generally acknowledged and adopted, is founded on the number, situation, and proportion of the *stamens* and *pistils*, whose uses and structure have been just explained. The following twenty-four classes owe their distinctions principally to the stamens. 1. *Monandria*, one stamen. 2. *Diandria*, two stamina. 3. *Triandria*, three. 4. *Tetrandria*, four. 5. *Pentandria*, five. 6. *Hexandria*, six. 7. *Heptandria*, seven. 8. *Octandria*, eight. 9. *Enneandria*, nine. 10. *Decandria*, ten. 11. *Dodecandria*, twelve. 12. *Icosandria*, twenty or more stamina, inserted into the calyx. 13. *Polyandria*, all above twenty inserted into the receptacle. 14. *Didynamia*, four stamina, two long and two short. 15. *Tetradynamia*, six stamina, four long and two short. 16. *Monadelphia*, the stamina united into one body by the filaments. 17. *Diadelphia*, the stamina united into two bodies by the filaments. 18. *Polyadelphia*, the stamina united into three or more bodies by the filaments. 19. *Syngenesia*, anthers united into a tube. 20. *Gynandria*, stamens inserted either upon the style or germen. 21. *Monœcia*, stamens and pistils in separate flowers, but on the same plant. 22. *Diœcia*, stamens and pistils, like the former in separate flowers, but on two separate plants. 23. *Polygamia*, stamens and pistils separate in some flowers, united in others, either on one, two, or three distinct plants. 24. *Cryptogamia*, stamens and pistils, either not well ascertained, or not to be numbered with certainty.

The *orders*, or subdivisions of the classes are generally marked by the number of the pistils or by some other circumstances equally intelligible. The names of these as well as of the classes, are both of Greek derivation, and designate the functions of the respective organs.

In the following table the reader will find the names of the classes, and also those of the several orders which are included in each class.

TABLLE OF THE ORDERS.

Classes.	*Number and Names of the Orders.*
1. Monandria.	2. Monogynia, Digynia.
2. Diandria.	3. Monogynia, Digynia, Trigynia.
3. Triandria.	3. Monogynia, Digynia, Trigynia.
4. Tetrandria.	3. Monogynia, Digynia, Tetragynia.
5. Pentandria.	6. Monogynia, Digynia, Trigynia, Tetragynia, Pentagynia, Polygynia.
6. Hexandria.	5. Monogynia, Digynia, Trigynia, Tetragynia, Polygynia.
7. Heptandria.	4. Monogynia, Digynia, Tetragynia, Heptagynia.
8. Octandria.	4. Monogynia, Digynia, Trigynia, Tetragynia.
9. Enneandria.	3. Monogynia, Trigynia, Hexagynia.
10. Decandria.	5. Monogynia, Digynia, Trigynia, Pentagynia, Decagynia.
11. Dodecandria.	5. Monogynia, Digynia, Trigynia, Pentagynia, Dodecagynia.
12. Icosandria.	5. Monogynia, Digynia, Trigynia, Pentagynia, Polygynia.
13. Polyandria.	7. Monogynia, Digynia, Trigynia, Tetragynia, Pentagynia, Hexagynia Polygynia.
14. Didynamia.	2. Gymniospermia, Angiospermia.
15. Tetradynamia.	2. Siliculosa, Siliquosa.
16. Monadelphia.	8. Tirandria, Pentandria, Octandria, Enneandria, Decandria, Endecandria, Dodecandria, Polyandria.
17. Diadelphia.	4. Pentandria, Hexandria, Octandria, Decandria.
18. Polyadelphia.	4. Pentandria, Dodecandria, Icosandria, Polyandria.
19. Syngenesia.	6. Polygamia æqualis, Polygamia superflua, Polygamia frustrania, Polygamia necessaria, Polygamia segregata, Monogamia.
20 Gynandria.	9. Diandria, Triandria, Tetrandria, Pentandria, Hexandria, Octandria, Decandria, Dodecandria, Polyandria.
21. Monœcia.	11. Monandria, Diandria, Triandria, Tetrandria, Pentandria, Hexandria, Heptandria, Polyandria, Monadelphia, Syngenesia, Gynandria.
22. Diœcia.	15. Monandria, Diandria, Triandria, Tetrandria, Pentandria, Hexandria, Octandria, Enneandria, Decandria, Dodecandria, Icosandria, Polyandria, Monadelphia, Syngenesia, Gynandria.
23. Polygamia.	3. Monœcia, Diœcia, Triœcia.
24. Cryptogamia.	4. Filices, Musci, Algæ, Fungi.
Appendix.	1. Palmæ.

We cannot dismiss this article without expressing a strong desire that some one of our Botanical Professors would favour the public with a view of the beautiful system of Linnæus in an English dress. To the learned, it is true, this would be unnecessary; but it should be recollected that the study of botany, unlike the study of anatomy, is, as it were, by the great Author of nature, intended for the instruction of those who may be said to have scarcely any other medium of access to the rich stores of wisdom which this science displays. Why should the simple rustic who can read his native language be prevented by the appalling forms of a dead language, from feeling, in all its force, the lesson on the bounty and wisdom of his benevolent Maker, which he may read in those astonishing productions of nature, which, with so little concern, he every day treads under foot, or sees as if he saw them not?

BOTANY BAY, a bay on the east coast of New Holland, so called by Capt. Cook, from the great quantity of plants found there by Sir Joseph Banks, and Dr. Solander, in the year 1770. The bay is capacious, safe, and convenient: the harbour is about a quarter of a mile broad at the entrance. On the banks are great quantities of oysters, muscles, cockles, and other shell fish, which seem to form the principal article of food to the savages, who go into shoal water with their little canoes, and pick them out with their hands.

BOTTLE, a small vessel of glass, or other matter, with a narrow mouth to put liquor in. Bottles of glass are better for cyder than those of stone. It is a very common practice to clean wine bottles with leaden shot; but from its pernicious tendency it cannot be too strongly censured; several of the particles of the shot are by the necessary agitation in cleaning, often fixed in the bottom of the bottles, where they are slowly dissolved, and communicate a deleterious quality to the liquors. Instead of this a solution of potash is recommended, as being both cheaper, and more effectual, and perfectly safe. A very small portion of potash dissolved in warm water will celan two gross of bottles.

BOTTOM, in navigation, is used to denote as well the channel of rivers and harbours, as the body or hull of a ship: thus, in the former sense, we say, a gravelly bottom, clayey bottom, sandy bottom, &c. and in the latter sense, a British bottom, a Dutch bottom, &c. By statute, certain commodities imported in foreign bottoms, pay a duty called petty customs, over and above what they are liable to if imported in British bottoms.

BOTTOMRY, in commerce, a contract for the borrowing of money upon the keel or bottom of a ship; that is, when the master of a ship binds the ship itself, that if the money be not paid by the time appointed, the creditor shall have the ship.

BOTTOMRY is also where a person lends money to a merchant, and the lender is to be paid a greater sum at the return of the ship.

BOTTONY. A cross bottony, in heraldry, terminates at each end in three buds, knots, or buttons, resembling the trefoil.

BOTTS. See Oestris.

BOUNTY, in commerce, a premium paid by the government to the exporters of certain British commodities, on their taking oath, or, in some cases, giving bond, not to re-land the same in England.

BOW, a weapon of offence made of steel, wood, horn, or other elastic matter, which, after being bent by means of a string fastened to its two ends, in returning to its natural state, throws out an arrow with great force.

Bow *of a ship,* that part of her head which is contained between the stern and the after-part of the fore-castle, on either side; so that a ship hath two bows, the starboard and the larboard, or, as they are sometimes called, the weather and the lee bow.

BOW-*line,* in sea-language, a rope fastened near the middle of the leech, or perpendicular edge of the principal square sails, by three or four subordinate parts called bridles, and leading forward towards the bow, whence it derives its name. The use of the bow-line is to make the sail stand sharp or close, or by a wind.

BOWSPRIT, or *bolt-sprit,* a kind of mast, resting slopewise on the head of the main stem, and having its lower end fastened to the partners of the fore-mast, and farther supported by the fore-stay. It carries the sprit-sail, sprit-topsail, and jack-staff.

BOX, or *box-tree.* See Buxus.

BOYAU, in fortification, a ditch covered with a parapet, which serves as a communication between two trenches.

BRABEJUM, the *African almond,* a genus of the monœcia order and polygamia class of plants. Male corolla four or five parted; stamina four inserted in the throat; style bifid and abortive; the hermaphrodite has a four-parted corolla, revolute upwards with four stamina; one pistil with two stigmas. The fruit a roundish drupa, with a globular seed. The only species is the Brabejum stellatifolium, which is a native of the Cape of Good Hope.

BRACE, in architecture, a piece of timber framed in with bevil joints, the use of which is to keep the building from swerving either way. When the brace is framed into the kinglesses, or principal rafter, it is by some called a strut.

Braces, in the sea-language, are ropes belonging to all the yards of a ship, except the mizen, two to each yard, reeved through blocks that are fastened to penants, seized to the yard-arms. Their use is either to square or transverse the yards.

Brace, in writing, a term used to signify a crooked line, as }, made at the end of two or more articles in an account, the amount of which is usually placed in the centre of the brace.

BRACELET, an ornament worn on the wrist, much used among the ancients: it was made of different materials, and in different fashions, according to the age and quality of the wearer.

BRACKETS, in a ship, the small knees, serving to support the galleries, and commonly carved. Also, the timbers that support the gratings in the head are called brackets.

BRADS, among artificers, a kind of nails used in building, which have no spreading heads, as other nails have. They are distinguished, by ironmongers, by six names; as joiners'-brads, flooring brads, batten brads, bill-brads, or quarter-heads, &c.

BRADYPUS, or *sloth,* a genus of animals of the order of bruta. There are three species. 1. Bradypus tridactylus, or three-toed sloth. Its general appearance is very uncouth; the body is thick; the fore legs much shorter than the hinder; the feet small, but armed with three strong claws. The head is small, with a rounded or blunt snout, which is black and naked, the eyes are small; also the ears which are close to the head. The general colour of the hair which is coarse and thick, is a greyish brown. The sloth feeds entirely on vegetables, and makes a dismal yell, which frightens other animals from the spot. This animal is an inhabitant of South America. 2. Bradypus didactylus, or two-footed sloth, is also a native of South America, and of Ceylon. In its general appearance it resembles the former, only it has two claws on the fore-feet, and is more active. 3. Bradypus ursinus, or the ursine sloth, is a native of India, and very much resembles the bear. It is gentle and good natured, feeding chiefly on vegetables and milk, and is remarkably fond of apples.

BRAIL, or *brails,* in a ship, are small ropes made use of to furl the sails across: they belong only to the two courses and the mizen-sail.

BRAIN. See Anatomy.

BRAN, the skins or husks of corn, especially of wheat ground, separated from the corn by a sieve or boulter. It is of wheat bran that starch-makers make their starch. The dyers reckon bran among the non-colouring drugs, and use it for making the sour waters, with which they prepare their dyes.

BRANCHIÆ, *gills,* in the anatomy of fishes, the parts corresponding to the lungs of land-animals, by which fishes take in and throw out again a certain quantity of water impregnated with air. All fishes, except the cetaceous ones and the lamprey, are furnished with these organs of respiration, which are always eight in number, four on each side the throat.

BRANDY. This well known fluid is the spirit distilled from wine. The greatest quantities are made in Languedoc, where this manufacture, *so pernicious to society,* first commenced. It is obtained by distillation in the usual method by a still, which contains five or six quintals of wine, and has a capital and worm tube applied. Its peculiar flavour depends on the nature of the volatile principles, or essential oil, which come over along with it, and likewise, upon the management of the fire, the wood of the cask in which it is kept, &c. It is said, that our rectifiers imitate the flavour of brandy, by adding a small proportion of nitrous ether to the spirit of malt or molasses. See Alcohol.

BRASS. An elegant yellow-coloured compound metal, consisting of copper combined with about one-third of its weight of zinc. The best brass is made by cementation of calamine, or the ore of zinc, with granulated copper. See Copper.

BRASSICA, in botany, a genus of the tetradynamia siliquosa class and order. Natural order of siliquosa or cruciformes

cruciferæ, Jussieu. Essential character; calyx erect, converging; seeds globular; a gland between the shorter stamens and the pistil, and between the longer and the calyx. There are sixteen species, among which are the various kinds of cabbages, bore-coles, brocolis, and turnips.

BRAWN, the flesh of a boar soused or pickled; for which end the boar should be old; because the older he is, the more horny will the brawn be.

BRAZIL *wood*, in the arts. The tree which bears this wood is the cæsalpina crista. The wood is very hard, takes a high polish, and is so heavy as to sink in water. When chewed it gives a sweetish taste. It much resembles in appearance red saunders wood, but differs from [illegible] essentially in readily giving out its colour to water, which saunders wood does not.

Brazil wood is valuable for the beautiful orange and red colours, in various shades, which it furnishes to the dyer, but the colour is naturally very fugitive, though it may be to a certain degree fixed by various mordants.

BRAZING, the soldering or joining two pieces of iron together by means of thin plates of brass, melted between the pieces that are to be joined.

BREACH, in fortification, a gap made in any part of the works of a town by the cannon or mines of the besiegers, in order to make an attack upon the place. To make the attack more difficult, the besieged sow the breach with crow-feet, or stop it with chevaux de frize.

BREAD is a light porous spongy substance, prepared by fermentation and baking, from the flour of certain farinaceous seeds, especially wheat, and is the principal sustenance of man in the temperate regions of the northern hemisphere.

BREAKERS, a name given to those billows that break violently over rocks lying under the surface of the sea.

They are readily distinguished both by their appearance and sound, as they cover that part of the sea with a perpetual foam, and produce a hoarse roaring, very different from what the waves have in a deeper bottom.

BREECH, of a gun, the distance from the the hind part of the base ring to the beginning of the bore, it is always equal to the thickness of the metal at the vent.

BREWING is the art of making malt liquors, such as ale, beer, porter, &c. In this country the art of brewing is one of great importance, since fermented malt liquor forms the principal beverage of the inhabitants; and, indeed, it may be pronounced to be by far the most wholesome and nutritious of any of those liquors that are allowed to be essential to the support of the human frame; that is, provided it is produced from good materials, well managed during the process of preparation, and used in moderation. The process of brewing is differently conducted in different breweries, and is also varied in the same breweries, according to the nature and qualities of the liquor; but the following remarks will be found to be of general application to the art.

Before the malt is used it must be bruised, between rollers; and soft water is used for mashing and fermentation. The first step in brewing is mashing. This is done in a tub furnished with a false bottom, pierced with holes, and moveable, or fixed a few inches above the real bottom. There are two side-openings between the two; to one is fixed a pipe to convey water into the tun, and the other is used for drawing the liquor out. The malt is to be strewed over the false bottom, and a proper quantity of water let in from the upper copper; after which the mass is beaten by poles, or a machine like a rake or harrow, and moveable on a perpendicular beam with transverse arms for the rakes. When the mashing is completed, the tun is covered to prevent the escape of the heat, and the whole is suffered to stand, that the insoluble parts may separate from the liquor: the side-hole is then opened, and the clear wort discharged into the lower copper. The most eligible temperature in mashing is from 185 to 190 degrees, but for the first mashing the heat of the water must be less, and so in proportion to the dark colour of the malt.

The *wort* of the first mashing is always the richest in saccharine matter, but to exhaust the malt, a second and third mashing are requisite. *Thirty gallons* may be drawn from each bushel of malt, for sound small beer; *six and a half gallons* only for strong ale. Every bushel of malt absorbs, or retains, about three and a half gallons of water. The next process is *boiling and hopping;* and if only one kind of liquor is to be made, the produce of the three mashings is to be mixed; but if both ale and table beer are required, the wort of the first, or first and second mashings, is for the ale, and the remainder for the beer. The wort intended for the same liquor, after it comes from the tun, is put into the lower copper, and mixed with a proportion of hops; and the better the wort the more hops will be wanted. Hops contain gallic acid, and tanning matter, and deprive the sweet wort of the mucilage, which occasions the beer to keep without turning sour.

When the hops are mixed with the wort in the copper, the liquor is made to boil as fast as possible: after which it is discharged into shallow tubs, called *coolers*, where it remains till it is cool enough to undergo fermentation. From the coolers the liquor is transferred to the *working tun*, and with it is mixed a gallon of yeast to four barrels of beer. In four or five hours the fermentation begins, and it requires from 18 to 48 hours before the wort is fit to be barrelled. The fermentation still goes on in the barrels, and in a few days a copious discharge of yeast takes place from the bunghole, and the greater portion of gluten is disengaged. In brewing, the gluten is not wanted, but in bread it is indispensable, and alone renders it fit for use. Care must be taken to fill up the barrel every day with fresh liquor; this discharge lessens daily, and ends entirely in about a week, when the bunghole is closed, and the liquor is fit for use, after standing from a fortnight to three months, according to its strength, and the temperature at which it has been fermented. The fining of the beer is effected by the use of isinglass.

The following is a list of some of the unlawful substances seized at different breweries, and brewers' druggists' laboratories, in London, as copied from the minutes of the committee of

the House of Commons. Cocculus indicus multum, (an extract of the cocculus,) colouring, honey, hartshorn shavings, Spanish juice, orange powder, ginger, grains of paradise, quassia, liquorice, caraway seeds, copperas, capsicum, mixed drugs. Sulphuric acid is very frequently added to *bring beer forward,* or make it hard, giving new beer instantly the taste of what is 18 months old. According to Mr. Accum, the present *entire* beer of the London brewer is composed of all the waste and spoiled beer of the publicans, the bottoms of butts, the leavings of the pots, the drippings of the machines for drawing the beer, the remnants of beer that lay in the leaden pipes of the brewery, with a portion of brown stout, bottling beer, and mild beer. He says that opium, tobacco, nux vomica, and extract of poppies, have been likewise used to adulterate beer.

BREYNIA, in botany, a genus of the polyandria diœcia class and order of plants. The essential character is, male cal. one-leaved, five parted; cor. none; nect. five glands; filaments five, very short; anthers roundish. Fem. cal. and cor. as in the male; pist. germ. globose; style none; stigmas five; per caps. five-celled; seeds solitary. There is one species, a native of New Caledonia.

BRICK. Among the numerous branches of the art of fashioning argillaceous earths into useful forms, and hardening them by fire, the art of making bricks and tiles is by no means one of the least useful.

Common clay is scarcely ever found in a state approaching to purity on the surface of the earth. It usually contains a large proportion of siliceous earth. Bergman examined several clays in the neighbourhood of Upsal, and made bricks, which he baked with various degrees of heat, suffered them to cool, immersed them in water for a considerable time, and then exposed them to the open air for three years. They were formed of clay and sand. The hardest were those into the composition of which a fourth part of sand had entered. Those which had been exposed for the shortest time to the fire were almost totally destroyed, and crumbled down by the action of the air. Such as had been more thoroughly burned, suffered less damage; and in those which had been formed of clay alone, and were half vitrified by the heat, no change whatever was produced.

A kind of bricks called *fire-bricks* are made from slate-clay, which are very hard, heavy, and contain a large proportion of sand. These are chiefly used in the construction of furnaces for steam-engines, or other large works, and in lining the ovens of glass-houses, as they will stand any degree of heat. Indeed, they should always be employed where fires of any intensity are required.

BRIDGE, an erection of masonry, timber, or iron, consisting of one or more arches, over a river, canal, or valley, for the convenience of crossing the same. The principal parts of a bridge are the piers, the arches, the pavement, the foot way on each side, the rail or parapet, and the butments or ends of the bridge on the bank.

The piers of stone bridges should be equal in number, that there may be one arch in the middle, where commonly the current is strongest; their thickness is not to be less than a sixth part of the arch, nor more than a fourth; they are commonly guarded in front with angular starlings, to break the force of the current. As the piers of bridges always diminish the bed of a river, in case of inundations, the bed must be sunk or hollowed in proportion to the space taken up by the piers (as the waters gain in depth what they lose in breadth) which otherwise conduce to wash away the foundation and endanger the piers: to prevent this, they sometimes diminish the current, either by lengthening its course, or making it more winding; or by stopping the bottom with rows of planks, stakes, or piles, which break the current.

For the figure of the arches, some prefer the semicircle, others the elliptical form, and some the catenarian arch; but the arch of equilibration is the only perfect one, being equally strong in every part.

Among the bridges of antiquity, that built by Trajan over the Danube, it is allowed, is the most magnificent. It was demolished by his next successor Adrian, and the ruins are still to be seen in the middle of the Danube, near the city Warhel, in Hungary. It had 20 piers, of square stone, each of which was 150 feet high above the foundation, 60 feet in breadth, and 170 feet distant from one another, which is the span or width of the arches; so that the whole length of the bridge was more than 1530 yards, or nearly one mile.

This however is trifling when compared with the famous flying bridge in China, built from one mountain to another, and consisting of a single arch 400 cubits long, and 500 cubits high. There are several bridges of considerable note in our own country. The triangular bridge at Crowland in Lincolnshire is supposed to be the most ancient Gothic structure in the kingdom; it was erected about the year 860. Of modern bridges, the two finest in Europe are the Westminster and Blackfriars bridges, over the Thames, at London.

The grandest invention in the whole history of bridge-building is, unquestionably, that of iron bridges, an invention which belongs exclusively to British artists. The first erected on a large scale is that over the river Severn, at Coalbrook Dale, in Shropshire. This bridge is composed of five ribs, and each rib of three concentric arcs connected together by radiating pieces. The interior arc forms a complete semicircle; but the others extend only to the cills under the road-way. These arcs pass through an upright frame of iron at each end, which serves as a guide; and the small space in the haunches between the frames and the outer arc is filled with a ring of about seven feet diameter. Upon the top of the ribs are laid cast-iron plates, which sustain the road-way. The arch of this bridge is one hundred feet six inches in span; the interior ring is cast in two pieces, each piece being about seventy feet in length.

The second iron bridge in this country was that constructed by Messrs. Walkers at Rotherham designed by Mr. Thos. Paine. This bridge after being exhibited for some time in a bowling green at Paddington was to have been sent to America but Mr. Paine not being able to pay the expense, the manufacturers took it

back, and the malleable iron was afterwards used in constructing the bridge at Wearmouth. The erection of the bridge at Wearmouth gave an impulse to public taste, and excited an emulation among artists which has produced many examples, and more projects of iron bridges; and at the present time there are some in progress which manifest great improvements in the art.

BRIEF, any writ issued out of any of the king's courts of record at Westminster, whereby any thing is commanded to be done in order to justice.

Brief also signifies an abridgment of the client's case made out for the instruction of counsel, on a trial at law, which is to be fully but briefly stated.

BRIGADE, in the military art, a party or division of a body of soldiers, whether horse or foot, under the command of a brigadier. An army is divided into brigades of horse and brigades of foot: a brigade of horse is a body of eight or ten squadrons; a brigade of foot consists of four, five, or six battalions.

BRIGADIER is the general officer who has the command of a brigade. The eldest colonels are generally advanced to this post. He that is upon duty is brigadier of the day.

BRIGANTINE, a small light vessel, which can both row and sail well, and is either for fighting or giving chace. It has about twelve or fifteen benches for the rowers, one man to a bench: all the hands aboard are soldiers, and each man has his musquet lying ready under his oar.

BRIMSTONE. See Sulphur. Casts of medals have been taken off on a composition of which the chief ingredient is sulphur, and hence they are called sulphur casts. By this means the most curious antiques may, to all useful purposes be indefinitely multiplied. The composition is this: melt eight ounces of sulphur over a gentle fire, and with it mix an equal quantity of fine vermilion, stir it well together, and it will dissolve like oil, then pour it into the mould, which is first to be rubbed over with oil. When cool it may be taken and touched over with aqua-fortis, it will look like fine coral.

BRISTLE, a rigid glossy kind of hair, found on swine, and much used by brush makers, shoe-makers, sadlers, and others. They are chiefly imported from Russia and Poland. There is a heavy duty upon these.

BRIZA, in botany, quaking grass: a genus of the digynia order, and triandria class of plants; and in the natural method ranking under the 4th order, gramina. There are six species of briza: two of which are natives of Britain, viz.

1. Briza media, the middle quaking grass, and,

2. Briza minor, the small quaking grass. Both grow in pasture grounds.

BROCADE, a stuff of gold, silver, or silk, raised and enriched with flowers, foliages, and other ornaments, according to the fancy of the merchants or manufacturers.

BROKER, a name given to persons of several and very different professions, the chief of which are exchange-brokers, stock-brokers, pawn-brokers, and brokers simply so called, who sell household furniture, and second-hand apparel.

Brokers, *exchange*, are a kind of agents, or negociators between merchants, and between merchants and tradesmen, in matters of bills of exchange, or merchandise, for which they have so much commission.

Brokers, *stock*, are those employed to buy and sell shares in the joint stock of a company, or in the public funds.

Brokers, *pawn*, are persons who keep shops, and let out money, to necessitous people, upon pledges, on interest.

BROKERAGE, the fee paid to a broker for his trouble in negociating business between person and person.

BROMELIA, in botany, so named in memory of Olaus Bromel, a Swede, a genus of the hexandria monogynia class and order. There are nine species, one of which B. ananas, or pine-apple, a fruit now so well known in Europe, and so much esteemed for the richness of its flavour, is produced from an herbaceous plant which has leaves somewhat resembling those of aloe, and for the most part serrate on their edges, but much thinner and not so succulent as those of the aloe. The fruit resembles, in shape, the cone of some species of the pine-tree, from which it takes the vulgar name of pine-apple.

BLOMUS, Broom-grass, a genus of the digynia order, and triandria class of plants and, in the natural method, ranking under the 4th order, gramina. There are 25 species, of which seven are natives of Britain.

BRONCHOCELE, in surgery, a tumour rising in the forepart of the neck. This disorder is frequently called a Derbyshire neck, on account of the inhabitants of that county being much subject to it: probably for the same reasons that the inhabitants about the valleys of the Alps, and other mountainous countries, are so much affected with it.

BRONZE. A mixed metal, consisting chiefly of copper, with a small proportion of tin, and sometimes other metals. It is used for casting statues, cannon, bells, and other articles, in all which the proportions of the ingredients vary.

BRONZING, the art of varnishing wood, plaster, ivory, &c. so as to give them the colour of bronze. There are two sorts of composition used for this purpose, the red and the yellow; the latter is made of the finest copper dust, and to the former is added a small quantity of red ochre, well pulverized. Both are applied with varnish, and the work is dried over a chafing-dish as soon as bronzed.

BROOM, in botany. See Spartium, and Genista.

BROWALLIA, in botany, a genus of the angiospermia order, in the didynamia class of plants. There are two species, both annuals, viz.

1. Browallia demissa, with a single flower upon each footstalk. The flowers are of a light blue colour, sometimes inclining to a purple or red.

2. Browallia elata, with one or many flowers on each footstalk, is a native of Peru.

BRUCEA, in botany, a genus of the tetrandria order, and dioecia class of plants. There is one species, a shrub of Abyssinia.

BRUCHUS, a genus of coleopterous insects, with filiform antennæ, equal filiform

feelers, and acuminated lip. The species of this genus are in all twenty-five.

BRUNFELSIA, in botany, a genus of the monogynia order, and pentandria class of plants. The corolla is funnel-shaped, and very long; and the fruit an unilocular polyspermous berry. There are two species.

Brunfelsia Americana, rises six or eight feet high, has a woody branching rough stem, with oblong entire leaves on footstalks, and large whitish flowers by threes or fours at the ends of the branches, succeeded by round saffron-coloured soft fruit.

BRUSH, an instrument made of bristles, hair wire, or small twigs, to clean clothes, rooms, &c. and also to paint with. There are various sorts of them, distinguished by their shape or use. Brushes in which the hairs are fastened with silver wire are very superior to those in which iron wire is used, especially where they are used in or with water. Brushes are used for medical purposes, in rheumatic affections of the joints, paralysis, &c.

BRYONIA, BYRONY, a genus of the syngenesia order, and monœcia class of plants; in the natural method ranking under the 34th order, cucurbitaceæ. The calyx of the male is five-toothed, with a quinquefid corolla, and three filaments. In the female the calyx is dentated, the corolla quadrifid, the style trifid, with a roundish many-seeded berry. There are 19 species, of which the most remarkable are:

1. Bryonia Africana, African tuberous-rooted bryony.

2. Bryonia alba, rough or white bryony with red flowers, a native of dry banks under hedges in many parts of Britain.

3. Bryonia Bonariensis, bryony with hairy palmated leaves, divided into five parts, and obtuse segments. It [illegible] a native of warm countries.

4. Bryonia Creti[illegible] spotted bryony of Crete.

5. Bryonia racemosa, bryony with a red olive-shaped fruit. It is a native of warm climates, and perennial.

6. Bryonia variegata, the American bryony with variegated fruit.

BRYUM, in botany, a genus of the 56th natural order, viz. musci, belonging to the cryptogamia class of plants. The anthera is operculated or covered with a lid, the calyptra polished, and there is a filament arising from the terminal tubercle. There are 41 species, most of them natives of England.

BUBO, or BUBOE. See SURGERY.

BUBON, MACEDONIAN PARSLEY; a genus of the digynia order, and pentandria class of plants; and in the natural method ranking under the 46th order, umbellatæ. The fruit is ovated, striated, and villous. There are five species, which are propagated by seeds, and require the common culture of other exotic vegetables, viz.

1. Bubon Galbanum, or African ferula. 2. Bubon Gummiferum. The Galbanum of the shops is supposed to come from these two species. 3. Bubon Macedonicum. 4. Bubon rigidus, or rigid ferula, is a native of Sicily. 5. Bubon Cavigattum.

BUBROMA, a genus of the class and order polyadelphia dodecandria. The essential character is calyx three-leaved: petals, five-arched, semibifid: anthers, on each filament, three: stigma, simple: capsule, muriate, ending in a five-rayed star.

There is one species, a large tree of the West Indies, resembling the elm.

BUCCINATOR. See ANATOMY.

BUCCINUM, the TRUMPET-SHELL, a genus of univalve shells, shaped, in some degree, like a horn, or other wind instrument.

This is a very numerous genus, the principal species of which are the pomum, spindle-shell, the mitre-shell, the Midas-ear-shell, the great Triton-shell, the tower of Babel-shell, &c.

BUCCO, the *barbet*, in natural history, a genus of birds of the order picæ. Generic character; bill sharp-edged, compressed on the sides, notched on each side near the apex, bent inwards, with a long slit beneath the eyes; nostrils covered with incumbent feathers; feet formed for climbing. This bird is found in Brazil and Cayenne, is clumsy in its shape, and pensive and solitary in its manners. It is so lethargic in its disposition, that it will suffer itself to be shot at several times before it attempts to escape.

BUCEROS, the *hornbill*, in natural history, a genus of birds of the order picæ. Generic character: their bill is convex, curved, sharp-edged, large, outwardly serrate, with a horny protuberance near the base of the upper mandible; the nostrils are behind the base of the bill; the tongue is sharp-pointed and short; the feet gressorial. There are sixteen species enumerated by Gmelin, though Latham reckons only four; of these the most curious is, the B. Abyssinicus, or Abyssinian hornbill This is found in the country from which it takes its name, principally among fields of jaff, and nourishes itself by the green beetles which abound in them.

BUCHNERA, in botany, a genus of the angiospermia order, in the didynamia class of plants; ranking, in the natural method, under the 40th order, personatæ. There are eleven species, natives of the Cape, South America, and the West Indies.

BUCIDA, in botany, a genus of the order monogynia, in the decandria class of plants; ranging, in the natural method, under the 12th order, holoraceæ.

BUCK, in natural history, a male horned beast, whose female is denominated a doe See CERVUS.

BUCKET, a small portable vessel to hold water, often made of leather for its lightness and easy use in cases of fire. It is also the vessel let down into a well, or the sides of ships, to fetch up water.

BUCKING, the first operation in the whitening of linen-yarn or cloth: it consists in pouring hot water upon a tubful of yarn, intermingled with several strata of fine ashes of the ash tree. See BLEACHING.

BUCKLER, a piece of defensive armour used by the ancients. It was worn on the left arm, and composed of wickers woven together, or wood of the lightest sort, but most commonly of hides, fortified with plates of brass or other metal.

BUCKRAM, in commerce, a sort of coarse cloth made of hemp, gummed, calendered, and dyed several colours. It is put into those places of the lining of a garment, which are to be stiff and to keep their forms.

BUCK-*wheat*. See POLYGONUM

BUCKTHORN. See RHAMNUS.

BUDDING, a method of propagating various sorts of trees, particularly those of the wall-fruit kinds. See GARDENING.

BUDDLEIA, in botany, so named in honour of Adam Buddle, a genus of the monogynia order and tetrandria class of plants. Calyx and corolla quadrifid; and the stamina at the incisures of the corolla. Capsule bisulcated, bilocular, and polyspermous. There are eight species, the principal of which are, 1. *Buddleia Americana*, a native of the West Indies. It is a shrub, which grows ten or twelve feet high. 2. *Buddleia* occidentalis, a native of Carthagena. This grows to a greater height than the former, and has numerous branches. 3. *Buddleia* globosa is a native of Chili. It is a beautiful shrub, and the flowers are of an orange colour.

BUFF, in commerce, a sort of leather prepared from the skin of the buffalo, dressed with oil, after the manner of shammy. This forms a considerable article in commerce all along the coast of Africa.

BUFFALO. See BOS.

BUFO, the *toad*. See RANA.

BUFONIA, *toad grass*: a genus of the digynia order, belonging to the tetrandria class of plants; and in the natural method ranking under the 22d order, caryophylleæ. The calyx is four leaved; the corolla, four petalled; the capsule is monospermous. There is but one species, a native of Britain.

BUG. See CIMEX.

BUILDING. See ARCHITECTURE.

BUILDINGS, *laws concerning*. The buildings of London are regulated by what is denominated the building-act, which repeals and amends several former acts for the same purpose. Surveyors of districts are appointed to see the rules and regulations of this act properly complied with. Before any building is begun to be erected, the master workman is bound to give twenty-four hours' notice to the surveyor, who is to attend and view the building, and enforce the observance of the act.

BULBOCODIUM, *mountain-saffron*: a genus of the monogynia order, in the hexandria class of plants; and in the natural method ranking under the ninth order, spathaceæ. The corolla is funnel-shaped, and hexapetalous, with the heels narrow, supporting the stamina. There is one species, Bulbocodium vernum, which is a native of Spain, and has a bulbous root.

BULIMY, a disease in which the patient is affected with an insatiable desire of eating; and, unless he is indulged, he often falls into fainting fits. It is also called *fames canina*, canine appetite.

BULK-*heads* are partitions made athwart the ship, with boards, by which one part is divided from the other; as the great cabin, gun-room, bread-room, and several other divisions.

BULL. See BOS.

BULL, among ecclesiastics, a written letter dispatched by order of the Pope, from the Roman chancery, and sealed with lead, being written on parchment, by which it is partly distinguished from a brief.

BULL-*finch*. See LOXIA.

BULLA, in conchology, the name of a genus of shells, the character of which is thus defined: animal a limax; shell univalve, convoluted, and unarmed; mouth or aperture somewhat straightened, oblong, longitudinal, and at the base very entire; pillar lip oblique, and smooth. There are many species.

BULLION, uncoined gold or silver in the mass.

Those metals are called so, either when smelted from the native ore, and not perfectly refined, or when they are perfectly refined but melted down in bars or ingots, or in any unwrought body of any degree of fineness.

BUMALDA, in botany, a genus of the digynia order, belonging to the pentandria class of plants. The corolla is five-petalled, styles villose, capsule two-celled, two-beaked. There is one species, a native of Japan.

BUMELIA, a genus of the class and order pentandria monogynia. Corolla five-cleft, with five-leaved nectary, drupe one-seeded. There are seven species, all trees and shrubs, natives of the West Indies.

BUNIAS, in botany, a genus of the order siliquosa, and tetradynamia class of plants, and ranking under the thirty-ninth natural order, siliquosæ. The siliqua is deciduous, four-sided, muricated, or shagreened with unequal pointed angles. There are nine species, all annual plants.

BUNIUM, *pig-nut*, or *earth-nut*, a genus of the digynia order and pentandria class of plants, and in the natural method ranking under the 45th order, umbellatæ. The corolla is uniform, the umbel thick, and the fruit ovate. There is but one known species, viz. Bunium bulbocastanum, with a globular root. It grows naturally in moist pastures in Britain, and has a tuberous solid root, which lies deep in the ground.

BUNT *of a sail*, the middle part of it, formed designedly into a bag or cavity, that the sail may gather more wind. It is used mostly in top-sails, because courses are generally cut square, or with but small allowance for bunt or compass.

BUNT *lines* are small lines made fast to the bottom of the sails, in the middle part of the bolt-rope, to a cringle, and so are reeved through a small block, seized to the yard. Their use is to trice up the bunt of the sail, for the better furling it up.

BUOY, at sea, a short piece of wood, or a close-hooped barrel, fastened so as to float directly over the anchor, that the men who go in the boat to weigh the anchor, may know where it lies.

BUOY is also a piece of wood or cork, sometimes an empty cask, well closed, swimming on the surface of the water, and fastened by a chain, serving to mark the dangerous places near a coast.

BUPHAGA, in ornithology, a genus of the order of picæ, of which only a single species, (the Africana) has been discovered. It is found in Africa, and is called in English, the beef-eater, from this peculiarity, that it sometimes alights upon the backs of the cattle, and picks holes in them to get at the larvæ of the œstri, or gad-flies, deposited by those creatures in the flesh directly below the skin.

BUPHTHALMUM, *ox-eye*, a genus of the polygamia superflua order, and syngenesia class of plants, and in the natural method

ranking under the 49th order, compositæ. The receptacle is paleaceous; the pappus an indifferent rim; the seeds, emarginated on the sides; the stigmata of the hermaphrodite florets undivided. There are twelve species, all of which may be propagated by seeds. The following are the most remarkable:

1. Buphthalmum arborescens, rises with several woody stems to the height of eight or ten feet. The flowers are produced at the ends of the branches; they are of a pale yellow colour.

2. Buphthalmum helianthoides, a native of North America. It has a perennial root and an annual stalk, which rises six or eight feet high. The flowers are of a bright yellow colour.

BUPLEURUM, *hare's ear*, or *thorough-wax*, a genus of the digynia order, and pentandria class of plants, and in the natural method ranking under the 45th order, umbellatæ. The involucra of the partial umbels are large in proportion, and pentaphyllous; the petals involuted; the fruit roundish, compressed and striated. There are 14 species, the principal of which is, bupleurum fruticosum, or shrubby Ethiopian hartwort. It rises with a shrubby stem, five or six feet high, adorned with oblong, oval, entire leaves of a sea-green colour, placed alternately, with yellow flowers in umbels at the ends of the branches. It may be propagated by cuttings.

BUPRESTIS, a genus of coleopterous insects, distinguished by the uncommon brilliancy of their colours, which emulate the finest and most beautifully polished metals. The insects of this genus have the antennæ serrated, and as long as the thorax; feelers four, which are all filiform; head partly retracted within the thorax. The larvæ of the buprestes are said to live in the solid wood, or in the trunks of decayed trees; there are 27 species.

BURCARDIA, a genus of the class and order pentandria pentagynia. The essential character is, calyx five-leaved; corolla five-petalled; capsule angular, one-celled, three-valved, seven or eight-seeded. There is one species, a native of Guiana, annual.

BURDEN *of a ship* is its contents, or number of tons it will carry. The burden of a ship may be determined thus: multiply the length of the keel, taken within board, by the breadth of the ship, within board, taken from the midship-beam, and multiply the product by the depth of the hold, and divide the last product by 94, the quotient is the content of the tonnage required.

BURGESS, an inhabitant of a borough, or one who possesses a tenement therein. In other countries, burgess and citizen are confounded together; but with us they are distinguished: the word is also applied to the magistrates of some towns. Burgess is now ordinarily used for the representative of a borough-town in parliament.

BURGLARY, the breaking and entering the mansion-house of another in the night, with intent to commit some felony within the same, whether the felonious intent be executed or not. There must be a breaking and entry to complete this offence. If there be day-light enough to discern a man's face, it is no burglary.

BURGUNDY *pitch*, in medicine, the juice of the pinus abies, boiled in water, and strained through a linen cloth. It is chiefly employed for external purposes in inveterate coughs, &c.

BURIAL, the interment of a deceased person. The rites of burial make the greatest and most necessary care, being looked upon in all countries, and at all times, as a debt so sacred, that such as neglected to discharge it were thought accursed.

Burials, in law, persons are to be buried in woollen, or their representatives shall forfeit 5*l.* and affidavit is to be made thereof before a justice under a like penalty.

BURMANNIA, a genus of the monogynia order, in the hexandria class of plants; ranked in the natural method under the 10th order, coronariæ. The flower is small, and consists of three minute, ovated, oblong petals, situated at the mouth of the cup; the fruit is an involuted capsule, formed of three valves, with three cells, containing many small seeds. There are two species, of no note.

BURNING-*glass*, a convex or concave glass, commonly spherical, which being exposed directly to the sun, collects all the rays falling thereon into a very small space, called the focus; where wood, or any other combustible matter being put, will be set on fire.

The most remarkable burning-glasses, among the ancients, were those of Archimedes and Proclus; by the first of which the Roman ships besieging Syracuse, according to the testimony of several writers, and by the other, the navy of Vitalian besieging Byzantium, were reduced to ashes.

The best instrument of this kind known in modern times, was constructed by Mr. Parker of Fleet Street, at an expense of upwards of seven hundred pounds. It exposed a surface of 2 feet 8½ inches, when fixed in its frame.

BURN, in medicine and surgery, an injury received in any part of the body, either by fire itself, or by instruments put in a violent heat by the fire.

BURNISHER, a round polished piece of steel, serving to smoothe and give a lustre to metals.

Of these there are different kinds of different figures, straight, crooked, &c. Half burnishers are used to solder silver as well as to give a lustre.

BURR *pump*, or **Bildge** *pump*, differs from the common pump in having a staff, 6, 7, or 8 feet long, with a bar of wood whereto the leather is nailed, and this serves instead of a box. Two men standing over the pump thrust down this staff, to the middle whereof is fastened a rope for six, eight, or ten to hale by, thus pulling it up and down.

BURSERA, in botany, a genus of the diœcia polygamia class and order. The hermaphrodite calyx is triphyllous; the corolla tripetalous; the male capsule carnous; trivalved, and monospermous. The male is, corolla five-petalled, stamina, ten. There is but one species, viz.

Bursera gummifera, or gum elemi. It is found in abundance in woods in most of the Bahama islands, and grows in a very short time to a considerable height and thickness. The bark is brown, and very like the birch. It has yellow flowers, male and female on different trees. These are succeeded by purple

coloured berries, hanging in clusters. The seed is hard, white, and of a triangular figure, inclosed within a thin capsule. The fruit, when cut, discharges a clear balsam, esteemed a good vulne [illegible] for horses. On wounding the bark, a thick milky liquor is obtained, which concretes into a resin no way different from the gum elemi of the shops.

BUSHEL, a measure for dry goods, containing four pecks or eight gallons, or one-eighth of a quarter. A bushel, by 12 Henry VIII. c. 5, is to contain eight gallons of wheat: the gallon eight pounds troy-weight; the ounce twenty sterlings, and the sterling thirty-two grains, or corns of wheat, in the midst of the ear.

This standard bushel is kept in the exchequer. By act of parliament made in 1697, it is determined that every round bushel with a plain and even bottom, being 18½ inches in diameter, and 8 inches deep, should be esteemed a legal Winchester bushel.

BUSKIN, a kind of shoe, somewhat in the manner of a boot, and adapted to either foot, and worn by either sex. This part of dress, covering both the foot and mid-leg, was tied underneath the knee; it was very rich and fine, and principally used on the stage by actors in tragedy.

BUST, or Busto, in sculpture, &c. a term used for the figure or portrait of a person in relievo, shewing only the head, shoulders, and stomach, the arms being lopped off: it is usually placed on a pedestal or console.

BUTEA, in botany, a genus of the diadelphia decandria class and order. Calyx slightly two-lipped; corolla with a very long lanceolate banner; legume compressed, membranaceous; one-seeded at the tip. Two species; viz. Frondosa and Superba, found on the coast of Coromandel.

BUTNERIA, a genus of the pentandria monogynia class and order. Cor. five-petalled, filaments at top, connate with the petals; caps. five-grained, muricate. There are three species, shrubs of America and the West Indies.

BUTT, in commerce, a measure of wine containing two hogsheads, or 126 gallons.

Butt, or *butt-ends*, in the sea-language, are the fore-ends of all planks under water, as they rise, and are joined one end to another.

BUTTER, a fat unctuous substance, prepared from milk by churning. It was late before the Greeks appear to have had any notion of butter; their poets make no mention of it, and yet frequently speak of milk and cheese. The Romans used butter no otherwise than as a medicine.

BUTTON, an article of dress, serving to fasten clothes tight about the body, made of metal, silk, mohair, &c. in various forms. Metal buttons are formed two different ways; the blanks, or bases of the button, are either pierced out of a large sheet of metal, or cast. In the latter case, the shanks are previously fixed in the sand, exactly in the centre of the impression formed by each pattern, so as to have their extremities immersed in the melted metal, by which means they are firmly fixed in the button when cooled. The former process is generally used for yellow buttons, and the latter for those of white metal.

BUXBAUMIA, in botany, a genus of the natural order musci, and belonging to the cryptogamia class of plants.

BUXUS, the *box-tree*, a genus of the tetrandria order and monœcia class of plants ranking in the natural method under the 38th order, tricoccæ. Male calyx triphyllous; the germen an embryo. Female calyx tetraphyllous; petals three and styles three; capsule three beaked, and trilocular with two seeds. There is one species with three varieties. Buxus angustifolia, or the narrow-leaved box. 2. Buxus arborescens, with oval leaves. These two grow in abundance upon Boxhill, near Dorking in Surrey. There are two or three varieties of the second sort, one with yellow and the other with white striped leaves. Box wood is hard and smooth. It is used for rules, scales, quadrants, combs, &c. 3. Buxus suffruticosa or Dutch box, commonly used for bordering in flower gardens.

BUZZARD. See Falcon.

BY-LAW, is a private law made by those who are duly authorised so to do by charter, prescription, or custom, for the preservation of order and good government, within some particular place or jurisdiction. Moor, 583.

BYSSUS, in botany, a genus of the cryptogamia algæ, and the last in the scale of vegetation in that class. These mosses are composed of simple and uniform parts, and appear in the form of threads on rotten wood, rocks, and walls, and especially in damp cellars.

BYSTROPOGON, in botany, a genus of the didynamia gymnospermia class and order. The essential character is; calyx five-subulate, bearded at the opening; corolla, upper lip bifid; covers trifid; stamens distant. There are seven species.

C.

C, the third letter, and second consonant of the alphabet. It has two sounds, hard and soft; hard, like *k* before *a*, *u*, *o*, *l*, and *r*; as in call, cost, cup, clean, crop; and soft, like *s* before *i*, *e*, and *y*; as in city, cession, cyder: before *h* it has a peculiar sound, as in chance, chalk: in chord, chart, and some other words, it is hard like *k*: but in many French words it is soft before *h*, like *s*, as chaise, chagrin.

As a numeral, C signifies 100, CC 200, &c.

C, in music, the highest part in the thorough bass; again, a simple C, or rather a semicircle, placed after the cliff, intimates, that the music is in common time, which is either quick or slow; as it is joined with

allegro or adagio: if alone, it is usually adagio.

CABBAGE. See Brassica.

CABBALA, properly signifies tradition, and is the name of a mysterious kind of science, thought to have been delivered by revelation to the ancient Jews, and transmitted by oral tradition to those of our times; serving for the interpretation of the books both of nature and scripture.

CABLE, a strong rope, commonly of hemp, which serves to keep a ship at anchor. There is no merchant ship, however small, but has at least three cables. Every cable, of what thickness soever it may be, is composed of three strands, every strand of three ropes, and every rope of three twists; the twist is made of more or less threads, according as the cable is to be thicker or thinner. In the manufacture of cables, after the ropes are made, they use sticks, which they pass first between the ropes of which they make the strands, and afterwards between the strands of which they make the cable.

CABLED, in heraldry, a term applied to a cross formed of the two ends of a ship's cable.

CABOCHED, in heraldry, is when the heads of beasts are borne without any part of the neck, full faced.

CACALIA, in botany, Alpine colt's-foot, a genus of the polygamia æqualis order, and syngenesia class of plants. The receptacle is naked: the pappus hairy: the calyx cylindrical, oblong, and calyced. There are 33 species: the most remarkable are:

1. Cacalia ficoides, a native of the Cape of Good Hope; the leaves are pickled by the French, who esteem them much.

2. Cacalia kleinia, with a compound shrubby stalk. It grows naturally in the Canary islands, but has long been cultivated in the English gardens.

CACHEXY, in medicine, such a disposition of the body as depraves the nourishment throughout its whole habit.

CACHRYS, a genus of the digynia order, and pentandria class of plants; and in the natural method ranking under the 45th order, umbellatæ. There are five species, viz. 1. Cachrys hungarica, with a plain, fungous, channelled seed. 2. Cachrys libanotis, with smooth furrowed seeds. 3. Cachrys linearis, with plain channelled fruit. 4. Cachrys sicula, with doubled-winged leaves. 5. Cachrys trifida, with bipinnated leaves. All these are perennial plants, rising high, and bearing large yellow flowers.

CACTUS, *melon thistle:* a genus of the monogynia order, and icosandria class of plants; and in the natural method ranking under the 13th order, succulentæ. The calyx is monophyllous, superior, or above the receptacle of the fruit, imbricated; the corolla polypetalous; the fruit an unilocular polyspermous berry. When the plants are cut through, their inside is a soft, pale-green, fleshy substance, very full of moisture. The taste is agreeably acid, which, in a hot country, must render them grateful. There are 27 species, all natives of the West Indies. The two following are the most remarkable, viz. 1. Cactus cochenillifer, the species which the cochineal insects inhabit. 2. Cactus grandiflora, one of the creeping cereuses. The flower of this species, though very short-lived, is as beautiful as any in the vegetable system.

CADET is a military term, denoting a young gentleman who chooses to carry arms in a marching regiment as a private soldier. His views are to acquire some knowledge in the art of war, and to obtain a commission in the army.

CÆCILIA, the name of a genus of serpents. The generic character is, that the body is without scales, is smooth, and moves by means of lateral rugæ or wrinkles; the upper lip is prominent, and furnished with two tentacula; it has no tail. There are three species, viz. 1. Cæcilia tentaculata, the eel-shaped cæcilia: it is about a foot long, and of a brown colour, but the belly is white. It is a native of South America. 2. Cæcilia glutinosa, the white-sided cæcilia, is about the same size as the preceding, and also of a brown colour, only it has a white stripe along each side. 3. Slender cæcilia, is about 14 inches long, and the skin minutely granulated.

CÆSALPINIA, Brasiletto, or Brasilwood, a genus of the decandria class, and monogynia order of plants; and in the natural method ranking under the 33d order, lomentaceæ. The calyx is quinquefid, with the lowest segment larger in proportion. There are five petals, the lowest most beautiful. It is a leguminous plant. There are eight species.

CÆSARIAN *section,* in midwifery, an operation, by which the fœtus is delivered from the womb of its mother, when it cannot be done in the natural way.

CÆSURA, in the ancient poetry, is when, in the scanning of a verse, a word is divided so that one part seems cut off, and goes to a different foot from the rest; as,

Menti ri no li, nun quam men dacia prosunt.

CÆTERIS *paribus,* a Latin term, often used by mathematical and physical writers. the words literally signifying "the rest, or the other things, being alike, or equal."

CAIRN, a heap of stones thrown together, generally in a conical form, differing from barrows only in regard to the materials of which they are formed; the design of both appears to have been the same. Cairns are more common in Scotland and Wales than in England, evidently from the facility with which stones are procured in those countries.

CAISSON, in the military art, a wooden chest, into which several bombs are put, and sometimes only filled with gunpowder. This is buried under some work, of which the enemy intend to possess themselves; and when they are masters of it, is fired, in order to blow them up. It is also employed for a wooden frame, used in laying the foundations of the piers of a bridge.

CALAMANCO, a sort of woollen stuff manufactured in England and in Brabant. It has a fine gloss, and is chequered in the warp. Some are quite plain, others have broad stripes with flowers; some with plain broad stripes, some with narrow stripes, and others watered.

CALAMINARIS, or Lapis Calaminaris, in natural history, an ore of zinc, of a spongy substance, and a lax and cavernous texture, yet considerably heavy.

CALAMUS, a genus of the monogynia order, and hexandria class of plants; and in the natural method ranking under the 5th order.

tripetaloideæ. The calyx is hexaphyllous, there is no corolla, the fruit is a dry monospermous berry, imbricated backwards. There is but one species, viz.

Calamus rotang. The stem is without branches, has a crown at top, and is everywhere beset with straight spines. This is the real Indian cane, and grows in Sumatra.

CALCINATION. The fixed residues of such matters as have undergone combustion are called cinders in common language, and calces, or now more commonly oxides, by chemists; and the operation, when considered with regard to these residues, is termed calcination. In this general way it has likewise been applied to bodies not really combustible, but only deprived of some of their principles by heat. Thus we hear of the calcination of chalk, to convert it into lime, by driving off its carbonic acid and water; of gypsum or plaster stone, of alum, of borax, and other saline bodies, by which they are deprived of their water of crystallization; of bones, which lose their volatile parts by this treatment; and of various other bodies.

CALCULUS or Stone. This name is generally given to all hard concretions, not bony, formed in the bodies of animals. Of these, the most important, as giving rise to one of the most painful diseases incident to human nature, is the *urinary calculus* or stone in the bladder. Different substances occasionally enter into the composition of this calculus, but the most usual is the lithic acid.

Urinary calculi are usually spheroidal, sometimes they are polygonous, or resemble a cluster of mulberries. Their size is various; sometimes they are very small, and sometimes as large as a goose-egg. The colour of some of them is a deep brown. In some cases they are white; in others, of a dark grey. Their surface in some cases is polished like marble; in others, rough and unequal; sometimes they are covered with semi-transparent crystals.

Calculus *differentialis*, a method of differencing quantities, or of finding an infinitely small quantity, which being taken an infinite number of times, shall be equal to a given quantity. An infinitely small quantity, or infinitesimal, is a portion of a quantity less than any assignable one; it is therefore accounted as nothing; and hence two quantities only differing by an infinitesimal, are reputed equal. The word infinitesimal is merely respective, and implies a relation to another quantity. Infinitesimals are likewise called differentials, when they are considered as the differences of two quantities. Sir Isaac Newton calls them moments, considering them as momentry increments of quantities. The calculus differentialis, therefore, and the doctrine of fluxions, are the same thing, under different names, the latter given by Sir Isaac Newton, and the former by Mr. Leibnitz, who disputes with Sir Isaac the honour of the discovery. There is, however, one difference between them, which consists in the manner of expressing the differentials of quantities: Mr. Leibnitz, and most foreigners, express them by the same letters as variable ones, prefixing only the letter d: thus the differential of x is called dx, and the differential of y, dy: and dx is a positive quantity if x continually increase; and negative quantity if x decrease. We, on the other hand, following Sir Isaac Newton, instead of dx, write $\dot{x}$, (with a dot over it), and instead of dy, $\dot{y}$. See Fluxions.

Calculus *exponentialis*, among mathematicians, a method of differencing exponential quantities, and summing up the differentials of exponential quantities. By an exponential quantity is meant a power, the exponent of which is variable, as x^x, a^x. In order to difference an exponential quantity, nothing else is required than to reduce the exponential quantities to logarithmic ones, upon which the differencing is managed as in logarithmic ones.

Calculus, *integralis* or *summatorius*, is the method of summing up differential quantities, and the inverse of the calculus differentialis. It is applied to geometry, in the quadrature and rectification of curves, in cubing solids and measuring their surfaces, in the inverse method of tangents and in the doctrine of logarithms.

Calculus, *antecedental*, a geometrical method of reasoning, without regarding motion, and applicable to every purpose of fluxions. It was the invention of Mr. Glenie, who derived it from examining the antecedents of ratios with given consequents, and a given standard of comparison in the several degrees of augmentation and diminution which they undergo by composition and decomposition.

CALEA, a genus of the polygamia æqualis order, and syngenesia class of plants, in the natural method belonging to the 49th order, compositæ. Receptacle paleaceous, the pappus hairy, and calyx imbricated. There are seven species.

CALENDAR, a distribution of time, accommodated to the various uses of life, but more especially such as regard civil and ecclesiastical polity; in which sense it differs nothing from the modern almanacs. See Chronology.

CALENDER, a machine used in manufactories, to press certain woollens, &c. to make them even, smooth, and glossy, or to give them waves, or water them. This instrument is composed of two thick cylinders, of very hard wood, round which the stuffs to be calendered are wound: these are placed crossways between two very thick boards, the lower serving as a fixed base, and the upper moveable, by means of a thick screw, with a rope fastened to a spindle, which makes its axis: the uppermost board is loaded with large stones cemented together, weighing 20,000*lb.* or more. It is this weight that gives the polish.

CALENDS, a Roman chronology, the first day of each month, so called from the Greek καλειν to proclaim: it being customary on those days to proclaim the number of holydays in each month. The calends were reckoned backwards: thus, the first of May begins the calends of May; the 30th of April was the second of the calends of May; the 29th, the 3d, &c. to the 13th where the ides commence; which are also numbered in a retrograde order to the 5th, where the nones begin, and these are numbered after the same manner to the first of the month, which is the calends of April.

CALENDULA, in botany, the *marigold*, a genus of the polygamia necessaria order, in

the ral method ranking under the 49th order, compositæ. The receptacle is naked, there is no pappus, the calyx is polyphyllous and equal, the seeds of the disk membranaceous. There are 14 species, none of them natives of Europe. The common kind is so well known as to need no description.

CALENTURE, in medicine, a feverish disorder incident to sailors in hot climates; the principal sympton of which is, their imagining the sea to be green fields: hence, attempting to walk abroad in these, they are frequently lost.

CALIBER *compasses*, the name of a particular instrument used by gunners for measuring the diameters of shot, shells, &c. as also the cylinder of cannon, mortars, and howitzers. They resemble other compasses, except in their legs, which are arched, in order that the points may touch the extremities of the arch. To find the true diameter of a circle, they have a quadrant fastened to one leg, and passing through the other, marked with inches and parts, to express the diameter required: the length of each ruler or plate is usually between the limits of six inches and a foot. On these rulers are a variety of scales, tables, proportions, &c.

CALICO, a kind of manufacture made of cotton. It takes its name from Callicut, a city on the coast of Malabar, where it was first manufactured. In the East Indies the calicoes are all painted by the hand, which is performed with great expedition.

CALICO *printing;* the art of dyeing cloth (chiefly cotton and linen) topically; that is, impressing figures, in one or more colours, on certain parts of the cloth, while the rest of the surface is left in its original state. See DYEING.

CALLA, *African* or *Ethiopian arum*, a genus of the polyandria order, and gynandria class of plants, ranking in the natural method under the second order, piperitæ. There are four species; the most beautiful of which is the Calla Æthiopica, which is a native of the Cape of Good Hope.

CALLICARPA, a genus of plants of the class and order tetrandria monogynia. Calyx four-cleft; corolla four-cleft; berry four-seeded. There are seven species, all shrubs, natives of America and the West Indies.

CALLIGONUM, in botany, a genus of the polyandria digynia class of plants, without a flower: the fruit is an oval, compressed, striated, hairy pericarpium, with bifid tops, turning backwards; the seed single. There are three species.

CALLISIA, in botany, a genus of the monogynia order, in the triandria class of plants, and in the natural method ranking under the 6th order, ensatæ. The calyx is triphyllous; the petals are three; the antheræ are doubled; and the capsule is bilocular. There is but one species, a native of America.

CALLITRICHE, or *star-grass*, in botany, a genus of the digynia order, in the monandria class of plants, and in the natural method ranking under the 12th order, holoraceæ. It has no calyx, but two petals, and the capsule is bilocular and tetraspermous. There are 2 species.

CALLUS, or *Callosity*, any cutaneous, corneous, or osseous hardness, whether natural or preternatural: but most frequently it means the callus generated about the edges of a fracture, provided by nature to preserve the fractured bones, or divided parts.

CALODENDRUM, a genus of the class and order pentandria monogynia. The essential character is, calyx spreading, five-petalled; nect. five-leaved; capsule five-celled. There is one species, a native of the Cape.

CALOMEL. Chloride of mercury; frequently called mild muriate of mercury; and sometimes, but less properly, submuriate of mercury.

CALOPHYLLUM, in botany, a genus of the polyandria monogynia class of plants, the corolla consists of four roundish, hollow, patent petals, and is larger than the cup; the fruit is a large globose drupe. There are two species.

CALORIC. This name is applied to fire or the substance which produces the sensation we call heat, but never to the sensation itself, or the effect produced by fire. Animal heat is preserved chiefly by the inspiration of atmospheric air. If the hand be put upon a hot body, part of the caloric leaves the hot body and enters the hand; this produces the sensation of *heat*. On the contrary, if the hand be put upon a cold body, part of the caloric contained in the hand, leaves the hand to unite with the cold body; this produces the sensation of *cold*. Caloric comes to us from the sun, at the rate of 200,000 miles in a second of time. Caloric may be procured by combustion, percussion, friction, the mixture of different substances, and by means of electricity and galvanism.

In a latent state, caloric exists in all substances with which we are acquainted; but it combines with different substances in very different proportions. The reader will find an able and highly interesting article on this subject in Dr. Ure's Chemical Dictionary.

CALORIMETER, in chemistry, an instrument contrived by Lavoisier and La Place for measuring the comparative quantities of caloric in bodies.

CALVARY, in heraldry, a cross so called, because it resembles the cross on which our Saviour suffered. It is always set upon steps.

CALUMET, a kind of pipe used by the American Indians as the ensign of peace, and for religious fumigations. It is made of red, black, or white marble; the head resembles our tobacco-pipes, but is larger, and is fixed on a hollow reed, to hold it for smoking: they adorn it with rounds of feathers and locks of hair, or porcupines' quills, and in it they smoke in honour of the sun, especially if they want fair weather or rain. This pipe is a pass and safe conduct amongst all the allies of the nation which has it given: in all embassies the ambassador carries it as an emblem of peace, and it always meets with a profound regard.

CALX properly signifies lime, but was formerly used by chemists for a fine powder remaining after the calcination of metals and other mineral substances.

CALYCANTHUS, a genus of the polygynia order and icosandria class of plants, in the natural method ranking among the dubious order. Calyx, monophyllous, pitcher form, squarrose, with small coloured leaves; the

corolla consists of the leaves on the calyx; the styles numerous, each having a glandular stigma, seeds many, each with a hair within a succulent calyx. There are two species, 1. Calycanthus floridus or Carolina all-spice tree. 2. Calycanthus præcox, the first is cultivated with us, but the other not.

CALYPTRANTHES, a genus of the icosandria monogynia class and order. The essential character is, calyx superior, truncate, covered with a veil-shaped rib; corolla none; berry one-celled, one to four-seeded. There are six species, trees and shrubs of the West Indies.

CALYX, among botanists, a general term expressing the cup of a flower, or that part of a plant which surrounds and supports the other parts of the flower. See BOTANY.

CAMAX, in botany, a genus of the class and order pentandria monogynia. The essential character is, corolla wheel-shaped; fila-

CAMBLET, or CAMLET, a plain stuff composed of a warp and woof, which is manufactured in a loom. There are camblets of several sorts: some of goats' hair, both in the warp and woof; others, in which the warp is of hair, and the woof half hair and half silk.

CAMELLIA, in botany, a genus of the monadelphia polyandria class, and in the natural method ranking under the 37th order, columniferæ. The calyx is imbricated and polyphyllous, with the interior leaves larger than the exterior. There are three species, natives of China and Japan.

CAMELEOPARDALIS, the *cameleopard, giraffe*, in natural history, a genus of the mammalia and order pecora. The generic character is, horns covered with a bristly skin, bony and permanent; in the lower jaw eight teeth in front, and on each side the exterior tooth deeply bilobate. There is but one species; viz. the giraffe, which, when, fully grown, has been known to attain the extraordinary height among quadrupeds of seventeen feet. Its head is small; its aspect gentle; its fore parts are much higher than those behind; its colours arranged so as particularly to please the eye; and its form, notwithstanding the very great length of the neck, and a general singularity, possesses great beauty and elegance. It is a native of several parts of Africa, living in forests, principally upon the foliage of trees.

CAMELOPARDALIS, in astronomy, a constellation of the northern hemisphere, consisting of 32 stars, situated between Cepheus, Cassiopeia, Perseus, the two Bears, and Draco.

CAMELUS, CAMEL, a genus of quadrupeds of the order pecora. The generic character is, horns none; front teeth in the lower jaw six, somewhat thin and broad; canine teeth distant, in the upper jaw three, in the lower two; upper lip divided. There are seven species. 1. C. dromedarius, Arabian camel, or dromedary; is found in the warmer parts of Asia, and in the upper regions of Africa.

The general height of the Arabian camel, measured from the top of the dorsal bunch to the ground, is about six feet and a half; but from the top of the head, when the animal elevates it, not much less than nine feet: the head is small, the neck long, the body of a meagre shape; the legs slender, and the tail reaches to the joints of the hind legs; the feet are large, and are hoofed in a peculiar style, the under part being covered with a strong tough skin, which enables the animal to travel with ease in sandy and stony places. On each leg are six callosities. On the lower part of the breast is also a large tubercle, which is gradually increased by the constant habit which the animal has of resting upon it in lying down.

The general colour of the camel is an uniform dusky brown. Its hair is fine and soft, and serves for the basis of several kinds of stuffs.

2. C. Bactrianus, Bactrian camel, in its general appearance much resembles the Arabian, differing only in having two bunches on the back instead of one.

3. Camelus glama, or Peruvian sheep, is a native of South America, where it inhabits the

of a stag; measuring about four feet and a half in height to the top of the shoulders, and about six feet in length from nose to tail. Its general colour is a light ferruginous brown.

4. Camelus vicuna. The vicuna bears a general resemblance to the glama; but is of a lighter and more delicate aspect.

The vicuna affords the finest wool of any, and it is wrought into cloths of most exquisite silky softness and beauty, which are said to be too warm for common wear, unless made peculiarly thin.

5. Camelus paco. This species is said to be entirely confined to Peru, where the natives keep vast flocks of them for the sake of the wool. Those concretions, known by the name of bezoars, are often found in the stomach of this as well as of other species.

6. Camelus hunacus, or the guanaco, is a native of Peru. It is the largest of all the Peruvian animals of this kind, and is said sometimes to grow to the size of a horse. Its general colour is tawny above and white below.

7. Camelus arcuoanus. This species which inhabits Peru and Chili, is described as measuring about six feet in length, and about four in height. It is covered with woolly hair, and in its general appearance is not unlike a ram. This animal is employed by the inhabitants of Chili as a beast of burthen, as well as in ploughing.

CAMEO, in natural history, a genus of the semi-pellucid gems, approaching to the onyx structure, being composed of zones, and formed on a crystalline basis, but having their zones very broad and thick, and laid alternately one on another, with no common matter between them; usually less transparent, and more debased with earth than the onyxes.

CAMERA *Lucida*,* the name of an optical instrument invented by Dr. Hook, for the purpose of making the image of any object appear on the wall in a light room, either by day or night. The name is now given to an instrument recently invented by Dr. Wollaston, which is altogether different, both in its construction and use, from that of Dr. Hook. The use of this simple, but truly ingenious instrument, is for drawing objects in true perspec

tive, and for copying, reducing or enlarging other drawings.

CAMERA *Obscura*, in optics, a machine representing an artificial eye, wherein the images of external objects are distinctly exhibited, in their native colours, either invertedly or erect. For a description of this and the preceding instrument, see OPTICS.

CAMERARIA, a genus of the monogynia order and pentandria class of plants, ranking in the natural method under the 30th order, contortæ. There are two species, 1. Cameraria angustifolia, which grows to the height of eight feet. The flowers are produced at the ends of the branches. It is a native of Jamaica. 2. Cameraria latifolia, a native of Cuba. It rises to the height of 12 feet, dividing into several branches, with roundish pointed leaves placed opposite. The flowers are of a yellowish white, and grow in clusters at the end of the branches.

CAMP, the ground upon which an army pitch their tents. It is marked out by the quarter-master-general, who appoints every regiment their ground.

CAMPAIGN, in the art of war, denotes the space of time that an army keeps the field, or is encamped, in opposition to quarters.

CAMPANULA, in botany, a genus of the pentandria monogynia class and order. Natural order of campanaceæ. Essential character: corolla bell form, the bottom closed with stamineferous valves; stigma three-cleft; capsule inferior, gaping, with lateral pores. There are 78 species, most of them natives of our own country, well known in the gardens and fields.

CAMPHOR, is a white concrete crystalline substance, not brittle, but easily crumbled, having a peculiar consistence resembling that of spermaceti, but harder. It has a strong lively smell, and an acrid taste; is so volatile as totally to exhale when left exposed in a warm air; is light enough to swim on water; and is very inflammable, burning with a very white flame and smoke, without any residue.

Camphor is extracted from the roots, wood, and leaves of two species of laurus, the roots affording by far the greatest abundance. The method consists in distilling with water in large iron pots, serving as the body of a still, with earthen heads adapted, stuffed with straw, and provided with receivers. Most of the camphor becomes condensed in the solid form among the straw, and part comes over with the water.

The roots of zedoary, thyme, rosemary, sage, the inula hellenium, the anemony, the pasque flower or pulsatilla, and other vegetables, afford camphor by distillation.

CAMPHOROSMA, stinking ground pine; a genus of the tetrandria order in the monogynia class of plants, ranking in the natural method under the 12th order, holoraceæ. There are five species. Of these the principal is,

Camphorosma Monspeliensis, which grows by the road-side in Languedoc, and especially about Montpelier. It has been produced as a specific for the dropsy, and asthma.

CANAL, a kind of artificial river, made for the convenience of water carriage. See INLAND NAVIGATION.

CANARINA, a genus of the order monogynia, and hexandria class of plants. The calyx is six-leaved; corolla six-cleft, bell-form. There are two species.

CANARIUM, a genus of the diœcia order in the pentandria class of plants. It has male and female flowers; in both, the calyx has two leaves, and the corolla consists of three petals: the fruit is a drupa with a three-cornered nut. There is but one species.

CANCER, in astronomy, one of the 12 signs, represented on the globe in the form of a crab, and thus marked (♋) in books. It is the fourth constellation in the zodiac. It gives name to a quadrant of the ecliptic, viz.

CANCER, *tropic of*, in astronomy, a lesser circle of the sphere parallel to the equator, and passing through the beginning of the sign Cancer.

CANCER, in medicine, a roundish, unequal, hard, and livid tumour, generally seated in the glandulous part of the body.

CANCER, the *crab*, in natural history, a genus of insects of the order aptera. The generic character: eight legs in general, sometimes six or ten, besides two chelated arms; two eyes, distant, in general foot-stalked, elongated, and moveable: tail unarmed, and jointed. Animals of this genus at particular periods cast their shells, previously to which the limbs shrink, to facilitate their extrication. The loss of a limb, with other animals irreparable, is of little consequence to these, as a few weeks suffice to reproduce one: and in cases of bruise or mutilation, a consciousness of this eventual, and indeed speedy reproduction, induces them violently to rid themselves of the injured member, and to await in seclusion the formation of a complete substitute for it.

Some species which are unprovided by nature with any shelly covering, have recourse to such shells as they find best accommodated to their purpose, and in which their bodies are immersed, while their claws are protruded and unprotected. The correspondence of parts in both sides of almost all other animals is far from being always observable in these. The claspers on one side are often of extraordinary size, and on the other slender and small; and in some instances the large arm is obliged to be supported by the back of the animal, both while walking and at rest from its unwieldy and extravagant size. The genus comprehends an immense variety of species; but the chief division is into the Brachyouri and the Macrouri, or the short-tailed and the long-tailed: under the former of which the crab commonly used in this country for food is the principal. It is found chiefly on the rocky coasts. Among the Macrouri, the common lobster is the principal, and a well-known specimen. It inhabits in the clearest water, and at the base of rocks which project over the sea. It is extremely prolific, depositing about 12,000 eggs each time of laying. The warmth of summer is required for maturing them. The C. Norwegicus, or Norwegian crab, is naturally of a pale red colour, and variegated with yellow. It is longer, and more slender than the ordinary lobster.

CANCROMA, or *boat-bill*, in ornithology, a genus of birds belonging to the order of grallæ; the characters of which are: The bill is broad, with a keel along the middle; the nostrils are small, and lodged in a furrow; the tongue is small; and the toes are divided

These are two species: viz. Cancroma cancrophaga, or the brown boat-bill; and Cancroma cochlearia, the crested boat-bill.

CANDLE, a taper of tallow, wax, or spermaceti, the wick of which is commonly of several threads of cotton, twisted together.

A tallow-candle, to be good, must be half sheep's and half bullocks' tallow. The wick ought to be pure, sufficiently dry, and properly twisted, otherwise the candle will emit an unconstant vibratory flame, which is both prejudicial to the eyes and insufficient for the distinct illumination of objects.

There are two sorts of tallow-candles; the one dipped, the other moulded: the former are the common candles. The tallow is prepared by chopping the fat, and then boiling it in a copper; and when the tallow is extracted the remainder is subjected to the operation of a strong iron press, and the cake that is left after the tallow is expressed from it is called greaves: with this dogs are fed, and the greater part of the ducks that supply the London markets.

When the tallow is in proper order, the workman holds three of the broaches, with the cottons properly spread, between his fingers, and immerses the cotton into the vat containing the tallow: they are then hung on a frame and suffered to cool; and when cold they are dipped again, and so the process is continued till the candles are of the proper size.

The mould in which the moulded candles are cast, consists of a frame of wood, and several hollow metal cylinders, generally made of pewter, of the diameter and length of the candle wanted: at the extremity of these is the neck, which is a little cavity, pierced in the middle, with a hole large enough for the cotton to pass through. The cotton is introduced into the shaft of the mould by a wire being thrust through the aperture of the hook till it comes out of the neck: the other end of the cotton is so fastened as to keep it in a perpendicular situation, and in the middle of the candle; the moulds are then filled with warm tallow, and left to cool.

To make wax-candles with the ladle.—The wicks being prepared, a dozen of them are tied by the neck, at equal distances, round an iron circle, suspended directly over a large bason of copper tinned, and full of melted wax: a large ladleful of this wax is poured gently on the tops of the wicks till the candle arrives at the intended size.

In making wax-candles by the hand, they begin to soften the wax by working it several times in hot water, in a narrow deep cauldron. A piece of the wax is then taken out, and disposed by little and little around the wick, which is hung on a hook; so that they begin with the large end, diminishing as they descend towards the neck.

The cylindrical wax candles are either made as the former, with a ladle, or drawn. Wax candles, or tapers drawn, are so called because they are actually drawn in the manner of wire, by means of two large rollers of wood turned by a handle, which pass the wick through melted wax contained in a brass bason, and at the same time through the holes of an instrument like that used for drawing wire, fastened on the side of the bason.

CANDLE, Sale or auction by inch of candle, is when a small piece of candle being lighted, the by-standers are allowed to bid for the merchandize that is selling: but the moment the candle is out, the commodity is adjudged to the last bidder.

CANDY, or *sugar-candy*, a preparation of sugar, made by melting and crystallizing it six or seven times over, to render it hard and transparent.

CANELLA, in botany, a genus of the monogynia order, in the dodecandria class of plants, and in the natural method ranking under the 12th order, holoraceæ. There is but one species, viz.

Canella alba. It grows usually about 20 feet high, and 8 or 10 inches in thickness, in most of the Bahama islands. The bark is a warm stomachic.

CANE, CANNA. See ARUNDO. It is also the name of a long measure, which differs according to the several countries where it is used.

At Naples, the cane is equal to 7 feet 3 inches English measure; the cane of Thoulouse, and the upper Languedoc, contains 5 feet 8⅔ inches; at Montpelier, Provence, Dauphine and the Lower Languedoc, to 6 English feet 5½ inches.

CANES *venatici*, in astronomy, the greyhounds, two new constellations between the tail of the Great Bear and Bootes's arms, above the Coma Berenices. They comprehend 23 stars. In the British Catalogue they are 25.

CANINE *teeth*, in anatomy, are two sharp-edged teeth in each jaw, one on each side, placed between the incisores and molares.

CANIS, *dog*, in zoology, the name of a comprehensive genus of quadrupeds, of the order of feræ. The generic character is cutting teeth in the upper jaw six; the lateral ones longer, distant; the intermediate ones lobated. In the lower jaw six; the lateral ones lobated. Canine teeth solitary, incurvated. Grinders six or seven. There are 24 species.

1st. Canis familiaris, or common dog. The real origin of this species is in a state of uncertainty: wild dogs appear to be found in great troops in Congo, lower Æthiopia, and towards the Cape of Good Hope. They are said to be red-haired, with slender bodies and turned up tails, like greyhounds.

It is not, however, allowed that these wild dogs constitute the real species in a state of nature, but that they are the descendants of dogs once domesticated, and which have relapsed into a state resembling that of primitive wildness.

That which is supposed by Buffon to approach most nearly to the original animal, is known by the name of the shepherd's dog.

The dingo, or New Holland dog, approaches in appearance to the largest kind of shepherd's dog. This dog is capable of barking, though not so readily as the European dogs: it is extremely fierce, and has the same snarling and howling voice as the larger dogs in general.

The Pomeranian dog is distinguished by upright ears, long hair on the head, and an extremely curved tail, so as to form almost a circle. This dog is generally of a white colour.

The Siberian dog is nearly allied to the preceding, and may be subdivided into several races, differing as to strength and size.

The Iceland dog seems to differ but slightly from the preceding kind. It has a short muzzle, upright ears, and is covered with long rough hair.

The water-dog is distinguished by its curly hair, like wool. It is remarkable for its great attachment to the water, swims with great ease, and is used in hunting aquatic birds. Its feet approach more to a webbed form than those of most other dogs.

The great water spaniel is also distinguished in a similar manner by its curled hair, and its propensity to the water.

The Newfoundland dog is large, and from its strength and docility, is one of those which are best calculated for the security of a house. This animal is remarkably fond of plunging into the water.

King Charles's dog is one of the most elegant varieties of the dog, and it is recorded that King Charles the Second hardly ever walked out without being attended by some of this breed. It is in some degree allied to the small water spaniel, and is generally black, with the roof of the mouth of the same colour.

The Maltese dog is also a very small kind of spaniel, generally of a white colour.

The hound admits of some varieties. The old English hound is distinguished by its great size and strength; and its power of smelling.

The blood hound is a very large dog, taller and more beautifully formed than the old English hound, and superior to most others in speed, strength, and sagacity.

The pointer is employed principally in finding partridges and other game.

The Dalmatian, or coach dog, is an animal of great beauty. Its native country seems uncertain. It is white and beautifully marked with numerous black spots.

The Irish greyhound is the largest of all the dog kind, as well as the most beautiful and majestic in its appearance. It is only to be found in Ireland, and even there is become extremely rare.

The common greyhound is remarkable for the slenderness of its shape, the length of its snout, and the extreme swiftness of its course. The greyhound wants the faculty of quick scent, and follows his prey merely by the eye. The Italian greyhound is a small and beautiful variety of the preceding.

The naked dog is naturally divested of hair, and is supposed to have originated in some warm climate.

The mastiff is of a very strong and thick form, with a large head, a bold countenance, and large lips hanging down on each side.

The bull dog resembles the mastiff, but is smaller, with a flatter snout, and a greater ferocity of aspect. The bull dog is remarkable for the undaunted and savage pertinacity with which it provokes and continues the

every pack of hounds, and is very expert in forcing foxes or other game out of their coverts.

The turnspit is a breed very much on the decline in England, though still used in some other countries. It is a long-bodied, short-legged dog, with crooked or bowed knees and is commonly of a dusky grey, spotted with black. To these we may add the alco, or Peruvian dog, and several mixed breeds from the above.

2d. Canis lupus, or wolf, is distinguished from the dog by his superior size, stronger limbs, more muscular body, and greater breadth of the upper part of the face, while the whole form of it is longer: the tail has an inward direction; it is rather long and bushy. The wolf is a native of almost all the temperate and cold regions of the globe. It is found in most countries of Europe, but has been extirpated from our own island, as well as from Ireland.

The general colour of the wolf is a pale grey, with a cast of yellow.

The wolf is sometimes affected with madness, attended with similar appearances to those exhibited in that state by the dog, and productive of the same symptoms in consequence of its bite; this disease is said to happen to them in the depth of winter, and therefore, can never be attributed to the rage of the dog days.

3d. Canis Mexicanus, or Mexican wolf. In its general appearance it resembles the common wolf, but has a head twice as large, a thicker neck, and a less bushy tail: the colour of the body is cinereous, marked with some yellow spots. Above the mouth are several bristles as large, but not so stiff, as those of the hedgehog.

4th. Canis lycaon, or black wolf, is found both in Europe and America, as well as in some parts of Asia.

In America it is chiefly found in Canada, and in Europe only in the more northern regions.

5th. Canis hyæna, is a native of Asia and Africa. Its general size is that of a large dog. Its colour is a pale greyish-brown accompanied by a tawny cast, and the whole body is marked by several black transverse bands running from the back downwards. Hyænas generaly inhabit caverns and rocky places: they prowl about chiefly by night, and feed on the remains of dead animals as well as on living prey. They sometimes assemble in troops, and follow the movements of an army, in the hope of feasting on the slaughtered bodies.

6th. Canis crocuta, or spotted hyæna, resembles the former, but it is superior in size, and is marked all over with black spots. It is an African animal, and is found in Guinea, Æthiopia, and about the Cape of Good Hope.

7th. Canis aureus, or jackal, is a native of Asia and Africa, and appears to be most common in Barbary. It is about the size of a dog, and of a pale orange-yellow, with darker shades about the back and legs. The jackal resides in rocky places, and makes its principal excursions during the night. These animals go in

the lion, attending to the clamour, is said to follow till the jackals have hunted down the prey, and, having satiated himself, leaves only the remains to the jackals.

8th. Canis mesomelas, or Cape jackal, is common about the Cape of Good Hope, and is by some confounded with the jackal, to which, indeed, it seems to be very nearly allied.

9th. Canis Barbarus, Barbary jackal, has a long slender nose, sharp upright ears, and a long bushy tail. Its colour is a very pale brown. It is of the size of the common fox, but the limbs are shorter, and the nose more slender.

10th. Canis Ceilonicus, Ceylonese dog, is a native of Ceylon, but no particulars relative to its manners or history are known. It is a little larger than a common domestic cat. The claws of this animal resemble those of a cat more than of a dog, though not so long and slight in proportion.

11th. Canis vulpes, or fox, appears to be pretty generally diffused throughout all the northern and temperate parts of the globe; occuring with numerous varieties of colour and gradations of size, in most parts of Europe, the north of Asia, and America.

12th. Canis alopex, brant fox, is less than the common fox, and has a thicker and darker fur.

13th. Canis corsac, or corsac fox. The colour of this species is, in summer, a clear yellow-ferruginous; in winter mixed or shaded with grey.

14th. Canis Karagan, or Karagan fox. This is a small species, very common in almost all parts of the Kirghisian deserts and Great Tartary. Its general colour is grey; the head yellow, and the belly white.

15th. Canis cinero-argenteus, or fulvous-necked fox, inhabits North America. The crown of the head, neck, and back, are grey, mixed with black and white. In size this species is inferior to the common fox.

16th. Canis Virginianus, or Virginian fox, resembles the common fox in shape; has a sharp nose, long, sharp, upright ears, long legs, and a bushy tail: its colour is a whitish grey, with a cast of red about the ears. It is said never to burrow under ground, but to inhabit hollow trees: it is easily tamed, and is said to prey chiefly on poultry, birds, &c.

17th. Canis argentatus, silvery fox, resembles the common fox. It is an inhabitant of the forests of Louisiana, and preys on game.

18th. Canis lagopus, arctic fox, is inferior in size to the common fox. Its colour is a bluish-grey, which sometimes changes to perfect white. They inhabit Spitsbergen, Greenland, and Iceland. They swim well, and often cross from island to island in search of prey.

19th. Canis culpæus, Chili fox, is supposed to be a variety of the antarctic fox. It inhabits the open countries of Chili, in which it forms its burrows.

20th. Canis thous, or Surinam dog, is of a grey colour and entirely white beneath; its size is that of a large cat.

21st. Canis Bengalensis, Bengal fox, is scarcely half the size of the European fox. The face is cinereous, the body pale-brown. It is said to feed chiefly on roots and berries.

22nd Canis fuliginosus, sooty fox, in size and habit resembles the arctic fox, but is a distinct species. It is numerous in Iceland.

23d. Canis antarcticus, antarctic fox, is superior in size to the arctic fox. It is a native of the Falkland isles, and lives on water fowl.

24th. Canis zerda, the Fennec, or zerda, is a beautiful animal, and is principally found in Arabia. Its general length is about ten inches, and its colour yellowish-white. The ears are internally of a bright rose-colour, edged with white, and the tip of the tail is black. It inhabits the vast deserts of Zaara; it burrows in sandy ground, and is so exceedingly swift that it is very rarely taken alive. It feeds on insects, especially locusts, and barks like a dog.

Canis *major*, in astronomy, a constellation of the southern hemisphere, consisting of 28 stars, according to Ptolemy; of 13, according to Tycho; and 32 in the Britannic Catalogue.

Canis *minor*, **Caniculus**, or **Canicula**, in astronomy, a constellation of the northern hemisphere. In Ptolemy's Catalogue, the canis minor comprehends two stars; in that of Tycho, five; and in the Britannic Catalogue, 15.

CANKER, a disease incident to trees, proceeding chiefly from the nature of the soil. It makes the bark rot and fall.

CANNA, in botany, *Indian flowering reed*, or *Indian shot*, a genus of the monandria monogynia class and order. Natural order of Scitamineæ. Essential character: corolla six-parted, erect; lip two-parted, revolute; style lanceolate, growing to the corolla; calyx three-leaved. There are five species, most of them natives of America.

CANNABIS, in botany, *English hemp*, a genus of the diœcia pentandria class and order. Natural order of scabridæ. Essential character: male, calyx five-parted; corolla none; female, calyx one-leafed, entire, gaping on one side; corolla none; styles two; nut bivalve, within the closed calyx. There is but one species, viz. C. sativa. The uses of hemp are well known, as well as its great importance to the navy for sails and cordage. Exceedingly good huckaback is made from it for towels and common table-cloths. English hemp, properly manufactured, stands unrivalled in its strength, and is superior to the Russian.

CANNON. See Gunnery.

CANOE, a small boat, made of the trunk of a tree, bored hollow; and sometimes also of pieces of bark, sewed together. It is used by the natives of America to go a-fishing in the sea, or upon some other expedition, either by sea, or upon the rivers and lakes.

CANON, in mathematics is a rule to solve all things of the same nature with the thing proposed.

The tables of logarithms, artificial sines, and tangents, are called likewise by the name of canon.

CANTATA, in music, a song or composition, intermixed with recitatives, airs, and different movements, chiefly intended for a single voice, with a thorough bass, though sometimes for other instruments.

CANTEEN, a small vessel made of tin-plate or wood, in which soldiers, when on

their march, or in the field, carry their liquor They are cylindrical, like barrels 7½ inches in diameter, and about four inches deep, holding three pints.

CANTHARIS, a genus of coleopterous insects, with setaceous antennæ, the exterior wings of which are flexile, the thorax flatted, and the sides of the abdomen plicated. Linnæus enumerates 27 species of the cantharis.

CANTO, in music, the treble or at least the higher part of a piece.

CANTONED, in architecture, is when the corner of a building is adorned with a pilaster, and angular column, rustic quoins, or any thing that projects from the wall.

Cantoned, or **Cantonized**, *cantonee*, in heraldry, the position of such things as are borne with a cross, &c. between.

CAOUTCHOUC. This substance, sometimes termed, though improperly, *elastic gum*, and vulgarly, from its common application to rub out pencil marks on paper, *Indian rubber*, is obtained from the milky juice of different plants in hot countries. The principal of these are the Jatropha elastica, and Urceola elastica. To give this substance any particular form, the juice is applied in successive coatings on a mould of clay, and dried by the fire or in the sun; and when of a sufficient thickness, the mould is crushed, and the pieces are shaken out. The most remarkable property of this substance is its elasticity: when warmed, as by immersion in hot water, slips of it may be drawn out to seven or eight times their original length, and will return to their former dimensions nearly. Cold renders it stiff and rigid, but warmth restores its original elasticity. Exposed to the fire it softens, swells up, and burns with a bright flame. Oil of turpentine softens it, and forms a pasty mass, that may be spread as a varnish, but is very long in drying. A solution of caoutchouc in five times its weight of oil of turpentine, and this solution dissolved in eight times its weight of drying linseed oil by boiling, is said to form the varnish of air-balloons.

CAP, in a ship, a square piece of timber put over the head or upper end of any mast, having a round hole to receive the mast. By means of these caps the top-masts and top-gallant-masts are kept steady and firm in the tressel-trees where their feet stand.

Cap *of a gun*, a piece of lead which is put over the touch-hole of a gun to keep the priming from being wasted or spoiled.

CAPELLA, in astronomy, a bright fixed star of the first magnitude, in the left shoulder of the constellation Auriga. Its longitude is 17° 31′ 41″, its latitude 22° 51′ 47″.

CAPER. See Capparis.

CAPIAS, is a writ of two sorts, one whereof is called *capias ad respondendum*, before judgment, where an original is sued out, &c. to take the defendant and make him answer the plaintiff: and the other a writ of execution, after judgment, being of divers kinds.

CAPILLARY *vessels*, in anatomy, the smallest and extreme parts of the veins and arteries.

CAPITAL, the head, chief, or principal of a thing. Thus,

Capital, in geography, denotes the principal city of a kingdom, province, or state; as London is the capital of Britain.

Capital, in architecture, the uppermost part of a column or pilaster, serving as the head or crowning, and placed immediately over the shaft, and under the entablature.

CAPITULATION, in military affairs, a treaty made between the garrison or inhabitants of a place besieged, and the besiegers, for the delivering up the place on certain conditions.

CAPPARIS, a genus of the monogynia order, in the polyandria class of plants, and in the natural method ranking under the 25th order, putamineæ. There are 26 species, of which the principal is,

Capparis spinosa, or common caper, a low shrub, generally growing out of the joints of old walls or fisures of rocks in the warm parts of Europe. This plant is with great difficulty preserved in England. The pickle made from its berry is well known.

CAPRA, the goat-kind, in zoology, a genus of quadrupeds, of the order of pecora. The generic character is, horns hollow, turning upwards and backwards, compressed, rough, almost close at their base; front teeth in the lower jaw eight; canine-teeth, or tusks, none; chin bearded in the male. There are nine species and varieties.

1. Capra Ibex. It is found in several parts of Europe and Asia, and inhabits the Carpathian and Pyrenæan mountains, and various parts of the Alps.

It is an animal of great strength and agility, and is considerably larger than the domestic goat. Its colour is a greyish brown.

2. Capra Ægagrus, or Caucasan ibex, supposed to be the stock or origin of the domestic goat, is considerably superior to that animal in size, and its form in some degree resembles that of a stag. Its general colour is brown or grey, and the forehead is nearly black, which colour is continued down the back in the form of a stripe: the chin is furnished with a large brownish beard. and the horns, which are very large, and bend considerably backwards. The female is destitute both of horns and beard.

3. Capra Hircus, or common goat, is found in almost every part of the globe.

The colour of the domestic goat is various, being either black, brown, white, or spotted. The flesh is used as food by the inhabitants of Wales. The skin of the goat is peculiarly well adapted for the glove-manufactory, especially that of the kid.

The following are some of the varieties of the domestic goat.

1. Capra mambrica, or Syrian goat, is distinguished by the great length of the ears, which are pendulous. 2. Capra Angorensis, Angora goat, is generally of a milk-white colour, short-legged, with black, spreading, spirally twisted horns, and with the hair on the whole body disposed in long pendant spiral ringlets. It is from the hair of this animal that the finest camlets, &c. are prepared. 3. Capra depressa, or African goat, is a dwarf variety, found in some parts of Africa. 4. Capra reversa, or Whidaw goat. This is also a dwarf variety, found in Africa, where its flesh is considered as an excellent food.

5. Long-horned Whidaw goat. 6. Capricorn goat.

CAPRARIA, SWEET-WEED, a genus of the angiospermia order, in the didynamia class of plants; and in the natural method ranking under the 40th order, personatæ. There are five species.

CAPRICORN, in astronomy, one of the twelve signs of the zodiac, represented in globes in the form of a goat, and characterized by this mark ♑.

Tropic of CAPRICORN, a lesser circle of the sphere, which is parallel to the equinoctial, and at 23° 30′ distance from it southwards.

CAPRIMULGUS, GOAT-SUCKER, a genus of birds belonging to the order passeres. There are two species: 1. The Europæus, with the tubes of the nostrils hardly visible, which feeds on moths, gnats, &c. It appears in May, and leaves us in August. 2. The Americanus, a night bird, found in America.

CAPSICUM, in botany, GUINEA PEPPER, a genus of the monogynia order, in the pentandria class of plants; and in the natural method ranking under the 28th order, luridæ. The corolla is verticillated, and the fruit is a berry. There are five species; the principal are:

1. Capsicum annum, the common long-podded capsicum, commonly cultivated in the gardens. Of this there is one variety with red and another with yellow fruit.

2. Capsicum baccatum, bird pepper, rises with a shrubby stalk four or five feet high the fruit grows at the division of the branches, standing erect, these are small, oval, and of a bright red. This is the Cayenne pepper.

3. Capsicum grossum, the bell pepper. The fruit of this is red, and is the only kind proper for pickling.

CAPSTAN, or MAIN-CAPSTAN, in a ship, a large piece of timber resembling a windlass, placed behind the main-mast, formed into several squares with holes in them to admit bars. Its use is to weigh the anchors, to hoist up or strike down top-masts, &c.

CAPSULE, among botanists, a species of pericarpium or seed-vessel.

CAPTION, in law, is where a commission is executed, and the commissioners subscribe their names to a certificate, declaring when and where the commission was executed.

CAPURA, a genus of the class and order hexandria monogynia. The essential charac- [illegible]

East Indies.

CAPUT *mortuum*. The inert residuum of a distillation, or sublimation. The term is nearly obsolete.

CARABINE, a fire-arm, shorter than a musket, carrying a ball of twenty-four in the pound.

CARABUS, a genus of insects of the beetle kind. There are 34 species, mostly distinguished by their colour. The most remarkable is the crepitans, or bombardier. It keeps itself concealed among stones, and makes but little use of its wings; when it is touched, it makes a noise resembling the discharge of a musket in miniature, during which a blue smoke may be perceived proceeding from it. It may be made to play off its artillery, by scratching its back with a needle. Its chief enemy is another species of the same genus, but four times larger. When pursued, the bombardier has recourse to stratagem, by lying down in the path of the large carabus, which advances to seize it; but, on the discharge of the artillery, suddenly draws back, and remains a while confused, during which the bombardier conceals himself in some crevice.

CARACT, CARAT, or CARRAT, the name of that weight which expresses the degree of fineness that gold is of. The mint-master or custom, has fixed the purity of gold at 24 caracts; though it is not possible so to purify and refine that metal, but it will want still about one fourth part of a caract in absolute purity and perfection. The caract is divided into degrees to distinguish the greater or lesser quantity of alloy in gold.

It is also a certain weight which goldsmiths and jewellers use with which to weigh precious stones and pearls.

CARAVAN, in the East, signifies a company or assembly of travellers and pilgrims, and more particularly of merchants, who march in a body through the deserts, and other places, which are infested with Arabs or robbers.

CARAVANSERA, a large public building, or inn, appointed for receiving and lodging the caravans. It is commonly a large square building, in the middle of which there is a very spacious court; and under the arches or piazzas that surround it there runs a bank, raised some feet above the ground, where the merchants, and those who travel with them in any capacity, take up their lodgings, the beasts of burden being tied to the foot of the bank.

CARBON. When vegetable matter, particularly the more solid, as wood, is exposed to heat in close vessels, the volatile parts fly off, and leave behind a black porous substance, which is charcoal. If this be suffered to undergo combustion in contact with oxygen, or with atmospheric air, much the greater part of it will combine with the oxygen, and escape in the form of gas; leaving about a two-hundredth part, which consists chiefly of different saline and metallic substances. This pure inflammable part of the charcoal is what is commonly called *carbon;* and if the gas be received into proper vessels, the carbon will be found to have been converted by the oxygen into an acid, call the carbonic.

CARBONATES, compounds of carbonic acid with the salifiable bases. They are composed either of one prime of the acid and one of the base, or of two of the acid and one of the base. The former set of compounds is called carbonates, the latter bicarbonates.

Carbuncle, a gem highly prized by the ancients, probably the alamandine, a variety of noble garnet, it is of a deep red colour, with an admixture of scarlet.

CARBUNCLE, in heraldry, a bearing consisting of eight radii, four of which make a common cross, and the others a saltier.

CARCASE, a round vessel filled with combustible matters and pieces of gun or pistol barrels, loaded grenades, &c. Those for land service are large and thrown out of mortars.

CARD, among artificers, an instrument

consisting of a block of wood, beset with sharp teeth, serving to arrange the hairs of wool, flax, hemp, and the like: there are different kinds of them, as hand-cards, stock-cards, &c. but in the cotton and woollen manufactories the revolving cylindrical cards, or carding engines are in universal use.

CARDS, among gamesters, little pieces of fine thin pasteboard of an oblong figure, of several sizes, but most commonly in England three inches and a half long, and two and a half broad, on which are painted several points and figures. The moulds and blocks for making cards are exactly like those that were used for the first books: they lay a sheet of wet or moist paper on the block, which is first slightly done over with a sort of ink made with lamp-black diluted in water, and mixed with some starch to give it a body. They afterwards rub it off with a round list. The court-cards are coloured by means of several patterns, styled stane-files. These consist of papers cut through with a pen-knife, and in the apertures they apply severally the various colours, as red, black, &c. These patterns are painted with oil-colours, that the brushes may not wear them out; and when the pattern is laid on the paste-board, they slightly pass over it a brush full of colour, which, leaving it within the openings, forms the face or figure of the card.

CARDAMINE, *lady's smock*; a genus of the siliquosa order, in the tetradynamia class of plants. Of this there are 18 species; but the most remarkable is the cardamine pratensis, with a large purplish flower. It grows naturally in many parts of Britain, and is also called cuckow-flower.

CARDAMOM. See AMOMUM and MATERIA MEDICA.

CARDIA, or CARDIUM, in natural history, a genus of the vermes testaceæ, or shell-fish, the shell of which is formed of two ovals.

Of this genus there are 21 species, some nearly globose, others of a triangular figure, and others oblong. Under this genus are comprehended the cockles, ark-shells, &c. together with the pectini inauriti, or scallops without ears.

CARDIAC, an appellation given to such medicines as preserve or increase the strength of the heart.

CARDIALGIA, the *heartburn*, a disorder of the stomach attended with anxiety, a nausea, and often a reaching or actual vomiting.

CARDIOSPERMUM, *heart pea*, a genus of the trigynia order, in the octandria class of plants, and in the natural method ranking under the 39th order, trihilatæ. There are three species, natives of the East and West Indies.

CARDUUS, the *thistle*, a genus of the polygamia æqualis order, in the syngenesia class of plants, and in the natural method ranking under the 49th order, compositæ. Of this genus there are 51 species, ten of which are natives of Britain.

CAREENING, in the sea language, the bringing a ship to lie down on one side, in order to trim and caulk the other side.

CAREX, the *sedge*, a genus of the monœcia triandria class and order of plants, and in the natural method ranking under the 3d order, calamariæ. The male flowers are digested into a long spike; the calyx is an oblong and imbricated amentum, consisting of acute, and lanceolated scales, each containing one flower: there is no corolla; the stamina are three erect setaceous filaments of the length of the calyx the antheræ are oblong and erect. In the female flowers the calyx is the same as in the male; there are no petals, but there is an inflated oblong nectarium; the germen is triangular, and is placed within the nectarium; the style is very short; the stigmata are two or three; long, crooked, pointed, and hoary. There are 97 species.

CARICA, the *papaw*, a genus of the decandria order and diœcia class of plants, in the natural method ranking under the 38th order, tricoccæ. The species are, 1. Carica papaya, which grows to the height of twenty feet and naked till near the top. The leaves are large and the flowers bell shaped and yellow. When these fall away the germen swells to a fruit of the size of a melon. This and all parts of the tree abound with a juice used to kill ring worms. The fruit is made into a pickle, and the buds of the female flowers into a sweetmeat. 2. Carica prosoposa has a branching stalk, and the flowers are of a rose-colour, the fruit is shaped like a pear and sweeter than the papaya. Both species are natives of the East and West Indi

CARICATURA, in painting, denotes the concealment of real beauties, and the exaggeration of blemishes, but still so as to preserve a resemblance of the object.

CARIES, in surgery, the corruption of a bone when it is depraved of its periosteum, and becomes fatty, yellow, brown, and at last black. See SURGERY.

CARINA, in botany, a keel, the name which Linnæus gives to the lower concave petal of a pea-bloom, or butterfly-shaped flower, from its supposed resemblance to the keel of a ship.

CARISSA, a genus of the monogynia order and pentandria class of plants; ranking in the natural method under the 30th order, contortæ. It has two berries, many-seeded. There are two species, both trees, and natives of Africa.

CARLINA, one of the species of the thistle whose roots are used in medicine. They have a strong smell, and a subacrid, bitterish, weakly aromatic taste. They are accounted warm alexipharmics and diaphoretics.

CARLINGS, in a ship, are two pieces of timber, lying fore and aft, from beam to beam, for the ledges to rest on to which the planks are fastened.

CARMINATIVES, in pharmacy, medicines used in colics, or other flatulent disorders, to dispel the wind. See PHARMACY.

CARMINE, a powder of a very beautiful red colour, bordering upon a purple, and used by painters in miniature, though but rarely, because of its great price.

CARNATION, in botany. See DIANTHUS.

CARNATION *colour*, among painters, is understood of all the parts of a picture, in general, which represent flesh, or which are naked and without drapery.

CARNELIAN. See CHALCEDONY.

CARNIVAL, or CARNAVAL, a time of rejoicing, a season of mirth, observed with great solemnity by the Italians, particularly at Venice, lasting from Twelfth-day till Lent.

CARNIVOROUS, an appellation given to animals which naturally feed on flesh, and thence called beasts or birds of prey.

CAROLINEA, a genus of the monadelphia polyandria class and order. The essential character is; monogynious, calyx simple, tubular, truncate; petal ensiform; pome five-grooved, two-celled. There are two species, natives of Guiana and Tobago.

CAROTIDS, in anatomy, two arteries of the neck, which convey the blood from the aorta to the brain.

CAROXYLON, a genus of the pentandria monogynia class and order: the essential character is; corolla five-petalled; nect. five-leaved, converging, inserted into the corolla; seed clothed. There is one species.

CARPESIUM, a genus of the syngenesia polygamia superflua class and order: the essential character is; calyx imbricate; down none; recept. naked. There are two species.

CARP. See CYPRINUS.

CARPENTRY, the art of cutting, framing, and joining large pieces of wood, for the uses of building. It is one of the arts subservient to architecture, and is divided into house-carpentry and ship-carpentry: the first is employed in raising, roofing, flooring of houses, &c. and the second in the building of ships, barges, &c. The rules in carpentry are much the same with those of joinery; the only difference is, that carpentry is used in the larger and coarser work, and joinery in the smaller and curious.

CARPET, a sort of stuff wrought with the needle, or on a loom. Persian and Turkish carpets are in most esteem, but we have excellents ones made in England, particularly at Kidderminster. In weaving carpets, the design or pattern is traced in its proper colours on cartoons tied before the workman, who thereby knows what colours and shades he is to use, and how many stitches of the same colour. In this he is assisted by squares, and these again are subdivided into partitions corresponding with the threads of the warp.

The great carpets are made on frames and rollers not unlike those for tapestry, and under similar guidance where the pattern is intricate Carpet-making supports many thousands of the industrious poor of this country; and, being almost wholly founded on the produce of our own island, is of great importance as a national benefit.

CARPINUS, the HORNBEAM, a genus of the polyandria order, in the monœcia class of plants; and in the natural method ranking under the 50th order, amentaceæ. There are three species, viz.

1. Carpinus betulus, or common hornbeam; a deciduous tree, native of Europe and America.

2. Carpinus ostrya, the hop hornbeam, a native of Italy and Virginia.

3. Carpinus Virginiana, or flowering hornbeam.

CARPODETUS, a genus of the pentandria monogynia class and order. There is one species, a native of New Zealand.

CARRONADE, a short kind of ordnance, capable of carrying a large ball, and useful in close engagements at sea. It has its name from Carron, the place where this kind of ordnance was first made.

CARROT, DAUCUS, in botany. See DAUCUS.

CARTHAMUS, a genus of the order of polygamia æqualis, in the syngenesia class of plants, and in the natural method ranking under the 49th order, compositæ. Of this genus there are 10 species; but the only remarkable one is—

Carthamus tinctorius, with a saffron coloured flower, a native of Egypt and some of the warm parts of Asia. It is cultivated in many parts of Europe, and in the Levant, whence great quantities of it are annually imported into Britain for dyeing and painting.

CARTILAGE, in anatomy, a body approaching much to the nature of bones, but lubricous, flexible, and elastic.

CARTILAGINOUS *fishes*, those with cartilaginous instead of bony skeletons: they constitute an order of fishes, answering to the Chondropterygious and Branchiostegious of Linnæus.

CARTON, or CARTOON, in painting, a design drawn on strong paper to be afterwards traced through, and transferred on the fresh plaster of a wall to be painted in fresco. The cartons at Hampton-court are designs of Raphael Urbino. They are seven in number, and form only a small part of the sacred historical designs, executed by this artist, while engaged in the chambers of the Vatican, under the auspices of popes Julius II. and Leo X.

CARTOUCHE, in architecture and sculpture, an ornament representing a scroll of paper.

CARTOUCHE, in the military art, a case of wood, holding about 400 musket balls, besides six or eight balls of iron, of a pound weight, to be fired out of a hobit, for the defence of a pass, &c.

CARTRIDGE, a case of pasteboard or parchment, holding the exact charge of a gun. Those for cannon and mortars are usually in cases of pasteboard or tin, sometimes of wood, half a foot long.

CARUM, a genus of the digynia order, in the pentandria class of plants, and in the natural method ranking under the 25th order, umbellatæ. There is one species,—

Carum carui, the carraway of the shops, grows naturally in many places of Britain. It is a biennial plant; has a taper root like a parsnip, the taste of the seeds is strongly aromatic. It is much cultivated in Essex.

CARUS, in medicine, a sudden deprivation of sense and motion, affecting the whole body.

CARYATIDES, or CARIATES, in architecture, a kind or order of columns or pilasters under the figure of women dressed in long robes, after the manner of the Carian people, and serving instead of columns to support the entablement.

CARYOCAR, in botany, a genus of the tetragynia order, in the polyandria class of plants. The calyx is quinquepartite, the petals five, the styles most frequently four The fruit is a drupe, with nucleuses

and four furrows netted. There is one species.

CARYOPHYLLUS, the clove-tree, a *genus of the monogynia order, in the polyandria class of plants; and in the natural method ranking under the 19th order, hesperidæ. The corolla is tetrapetalous; the calyx tetraphyllous;* the berry monospermous, below the receptacle of the flower. Of this there is but one species, viz. the caryophyllous aromaticus, which is a native of the Molucca islands, particularly of Amboyna. It grows to the height of the laurel tree, and no verdure is ever seen under it. From the extremities of the branches grow quantities of flowers that are first white, then green, and at last red and hard, in which state they are properly cloves. When they become more dry they assume a yellow cast which ends in a dark brown. Cloves are stimulating aromatics, and yield abundance of oil.

CARYOTA in botany, a genus of the monoecia polyandria plants, classed by Linnæus under palmæ. There are two species.

CASE, among grammarians, implies the different inflexions or terminations of nouns, serving to express the different relations they bear to each other, and to the things they represent.

Case, among printers, denotes a sloping frame, divided into several compartments, each containing a number of types or letters of the same kind. From these the compositor takes out each letter as he wants it, to compose a page or form.

Case *of crown-glass* contains 12, 15, or 18 tables, according to the quality.

Case *of Newcastle green glass* contains 35 tables.

Case-*hardening*, a method of preparing iron, so as to render its outer surface hard, and capable of resisting any edged tool.

Case-*shot*, musket-balls, stones, old iron, &c. put into cases, and shot out of great guns.

CASHEW-*nut*. See Anacardium.

CASSIA, a genus of the monogynia order, in the decandria class of plants, and in the natural method ranking under the 33d order, lomentaceæ. The calyx is pentaphyllous; petals five; antheræ, upper, three barren; lower, three beaked: a leguminous plant. There are 51 species, of which C. diphylla, two-leaved cassia, is a shrub with a round stem; two semi-orbiculate, obtuse, striated leaves on a short petiole; stipules covering the whole branches. It is an annual. Native of the West Indies. Some of the cassias are, however, very tall trees, as the C. fistula, Alexandrian purging cassia, cassia stick tree, or pudding pipe tree, which is 50 feet high, with a large trunk dividing into many branches. Native of both Indies. C. senna, Egyptian cassia, or senna, the plant which produces the leaves commonly known in medicine by the name of senna, is an annual: it rises with an upright branching stalk, a foot high. It grows naturally in Persia, Syria, and Arabia, whence the leaves are brought, dried, and picked from the stalks, to Alexandria in Egypt, and being thence annually imported into Europe, it has the title Alexandrian added to it.

CASSIDA, a genus of insects, of the order of the coleoptera, with filiform or thread-like antennæ, thickest towards the extremities. Of this genus there are many species, some green, some grey, but most black; but all have been confounded by authors with the beetles *The larva casts its slough several times There is one species, of which the chrysalis resembles an armorial escutcheon. It is this* which produces our variegated cassida.

CASSINE, a genus of the trigynia order, in the pentandria class of plants, and in the natural method ranking under the 23d order, dumosæ. There are four species, all of them natives of warm climates.

CASSIOPEIA, a constellation in the northern hemisphere, situated between 45° and 75° N. declin. This constellation contains 55 stars, and passes vertically over the British Isles, and a large portion of Europe. In the year 1572, Tycho Brahe discovered, in this constellation, and very near the star κ, a new star which at first appeared larger than Jupiter, and more brilliant. The appearance of this star alarmed all the astronomers of the age, and was the cause of an astronomical controversy, in which the celebrated Beza was engaged. Some supposed it to be the star which appeared to the magi at the birth of Christ, and that it re-appeared to announce His second coming. After gradually decreasing for about 18 months, it totally disappeared.

CASSIUS, *precipitate of*, obtained from the muriate of gold by the means of tin. It is highly valued for the beauty of the colour which it gives to glass or enamel.

CASSOWARY. See Struthio.

CASSYTA, a genus of the monogynia order, in the enneandria class of plants. The corolla is in the form of a calyx, divided into six segments; the nectarium is composed of three truncated glands encompassing the germen; the interior filaments are glandular; and the drupe contains a single seed. There are two species.

CASTILLEIA, a genus of the didynamia angiospermia class and order. The essential character is calyx tubular, compressed; upper lip bifid, lower none; corolla, lower lip trifid, capsule two-celled. There are two species: natives of South America.

CASTING, among sculptors, is the taking of casts and impressions of figures, busts, medals, &c. The art of casting in plaster of Paris is extremely simple, and may be described in a few sentences. The first thing to be attended to is the taking of moulds from the objects that are to be represented in the casts. The mould should consist of as many pieces as the nature of the figure may require; these are to be made of fine plaster, for the purpose of taking the impression more effectually; and each part as it is made, must be neatly cut with a knife to the intended size, notched, so as to receive the plaster of which the adjoining piece is to be formed: and if necessary, a small piece of brass wire inserted in the middle of it in the form of a loop, by which, with a pair of pliers, the piece may be detached from the model, or from the cast, when, as is sometimes the case, it adheres too firmly to be detached by the hand. The smaller portions of a mould ought always to be surrounded with three, four, or more external parts, all joining by notches, and compactly bound together by a strong cord.

When a mould has been thus constructed, it should be allowed to dry gradually, and then nearly saturated with boiled linseed oil, applied to all its parts by means of a soft brush; and in a few days it may be used with safety, as it will then have acquired sufficient hardness. Before the intended cast be taken, the mould must be very carefully anointed with fine fresh hogs' lard, to prevent the adhesion of the cast: some advise the use of oil, but the oil is apt to sink into the mould and leave the surface dry.

To make the cast, let the plaster be dropped from the hand gradually into a bason containing a requisite quantity of water, stir it with a spoon until it acquires the consistence of cream; pour then a little of it into the mould, and move the mould in such a manner that the plaster shall touch every part of the interior surface, and pour out of the mould into the basin the portion of the plaster which remains and does not adhere to the surface. Repeat this process until the cast has become, by these successive coatings, of the desired thickness. The cast thus made must now be allowed to stand undisturbed until it be of sufficient hardness to admit of the mould being removed from it, which must be done with great care, particularly if the figure be complex.

Impressions of medals may be taken by first making a mould with sulphur, melted in an iron ladle, over a very slow fire; the medal being previously greased over with lard, and a rim of paper fastened round its edge, the sulphur is to be poured on it. In a few minutes it will set, and may be immediately detached from the medal, and is fit for use.

In making casts of this description the plaster should be laid on the mould first with a fine brush, to prevent air holes, and then worked to the requisite thickness by means of a thin flat knife, which is a much better method than putting a rim of paper round the mould and pouring on the plaster, as is commonly directed. To take off the cold effect which purely white plaster casts have, a little ochre is sometimes put into the water, which has a very pleasing effect: in the same way the cast may be rendered of a delicate flesh colour, or indeed of any colour required; or the figure may be made of one colour, and the ground of another.

CASTING, in a *Foundery* is the running of metals into any mould prepared for this purpose. See FOUNDERY.

CASTLE, a fortress or place rendered defensible by nature or by art. It frequently signifies the principal mansion of noblemen; and of this kind of buildings there were in the reign of Henry II. in England, no fewer than 115. Castles, according to Mr. Grose, are of no higher antiquity than the conquest.

CASTOR, the *beaver*, in zoology, a genus of the order of glires, of which the species are: 1. *Castor fiber*, or common beaver, is a native of the most northern parts of Europe, Asia, and North America. The tail is oval, and convex on the upper surface: and void of hair, except at the base. It has scaly divisions like the skin of a fish. The usual length of the beaver is three feet, and of the tail nearly one foot. The colour is a deep chesnut, but some are black. The hair is fine and glossy. The favourite resorts of the beavers are retired watery and woody places. In these situations they assemble in great numbers, living in a social state, and building their dwellings in an admirable manner. When they assemble, which is about June, or July, and have fixed on the place of their establishment, on the banks of some water, they begin by cutting down with their teeth the largest tree they can find, and always make it fall across the river. They then clear it from the branches while others cut down smaller trees, which they sink as piles, interweaving the branches with the larger stakes, and filling up the intervals with earth. The stakes paving the under part of the river, are placed perpendicularly, but the rest of the work slopes upwards to bear the pressure of the stream. On the great platform they construct their cabins, which have two openings, one for going on the land, and the other for throwing themselves into the water. The form of these cabins is oval, and from four to ten feet diameter. Some consist of three or four stories, and the walls are about two feet thick, raised perpendicularly on planks or stakes. They are very solid, and are plastered within and without. In the application of the mortar, beavers make use of their tails as trowels, and their feet for plastering. Each cabin has a magazine to hold bark and young wood, which is their favourite food; some villages consist of twenty or twenty-five cabins, but the usual number is twelve. The smallest cabins contain two, four, or six beavers, and some have as many as thirty. They have generally as many females as males. On the alarm of danger, they give each other warning by striking the water with their tail, the noise of which is heard at a considerable distance, and then each beaver seeks security, some by diving, others by concealing themselves within their habitations. The beaver often swims under the ice, and is then most easily taken, by watching the cabin and the hole where it is obliged to come up for air. Some beavers live solitarily in holes on the banks of rivers, but their fur is not so good as that of the others.

2. Castor huidobrius, or Chili beaver, is peculiar to South America, and lives chiefly on crabs and other fish. It is about three feet long, and very broad, with two sorts of hair, the shortest of which is highly esteemed, being as soft as velvet. It is a fierce animal, but does not construct a habitation like the common beaver, nor does it produce any castor.

CASTOR. A soft greyish-yellow or brown substance, found in four bags [illegible] inguinal region of the beaver. In a warm air it grows by degrees hard and brittle, and of a darker colour, especially when dried in chimneys, as is usually done.

CASUARINA, a genus of the monandria order, in the monoecia class of plants. There are five species, natives of New South Wales.

CAT. See FELIS.

CAT-*harpings*, in a ship, small ropes running in little blocks from one side of the shrouds, to the other, near the deck, to tighten the shrouds, for the security of the masts.

CAT-*heads*, two strong beams of timber projected almost horizontally over the ships' bows, on each side of the bowsprit. The cat-head

serves to suspend the anchor clear of the bow, when it is necessary to let it go: it is supported by a sort of knee, which is generally ornamented by sculpture.

CATACAUSTIC *curves*, in the higher geometry, that species of caustic curves which are formed by reflection.

The catacaustic of a circle is a cycloid, formed by the revolution of a circle along a circle. The caustic of the vulgar semi-cycloid, when the rays are parallel to the axis, is also a vulgar cycloid, described by the revolution of a circle upon the same base. The caustic of the logarithmic spiral is the same curve, only set in a different position.

CATACOMB, a grotto or subterraneous place for the burial of the dead.

The term is particularly used in Italy, for a vast assemblage of subterraneous sepulchres, three leagues from Rome, in the Via Appia, supposed to be the sepulchres of the ancients.

CATANANCHE, CANDIA LION'S FOOT, a genus of the polygamia æqualis order, in the syngenesia class of plants, and in the natural method ranking under the 49th order, compositæ. The receptacle is paleaceous; the calyx imbricated; the pappus furnished with awns by a caliculus of five stiff hairs. There are three species, of which the most remarkable is the catananche cerulea, a hardy, herbaceous, and ornamental plant for the flower-garden. There is a variety with double flowers.

CATAPLASM, an external topical medicine, of a soft consistence, known by the common name of poultice, and prepared of ingredients of different virtues, according to the intention of the physician.

CATARACT, a precipice in the channel of a river, caused by rocks, or other obstacles stopping the course of the stream, whence the water falls with a greater noise and impetuosity.

CATARACT. See SURGERY.

CATARRH, in medicine, a defluxion from the head upon the mouth and aspera arteria, and through them upon the lungs.

CATECHU, in chemistry, a substance obtained by decoction, and inspissation from the wood of the mimosa catechu, a native of India, is a very powerf[illegible]stringent, and contains a large proportion of tanning.

CATEGORY, in logic, a series or order of all the predicates or attributes contained under any genus.

Aristotle made ten categories, viz. quantity, quality, relation, action, passion, time, place, situation, and habit.

CATENARIA, in the higher geometry, the name of a curve line formed by a rope hanging freely from two points of suspension, whether the points be horizontal or not.

CATERPILLAR. See PAPILIO.

CATESBÆA, the *lily thorn*, a genus of the monogynia order and tetrandria class of plants: in the natural method ranking under the 28th order luridæ. There are two species. 1. Catesbæa spinosa, native of the island of Providence, and discovered by Mr. Catesby. It grows to the height of 10 or 12 feet and the flowers are of a yellow colour. 2 Catesbæa parviflora.

CATHARTICS, in medicine, are the same with what are commonly called purgatives See MEDICINE.

CATHETER, in surgery, a fistulous instrument, usually made of silver, to be introduced into the bladder, in order to search for the stone, or discharge the urine when suppressed. See SURGERY.

CATHETUS, in geometry, a line or radius falling perpendicularly on another line or surface: thus the catheti of a right angled triangle are the two sides that include the right angle.

CATOPTRICS, that part of optics that treats of reflex vision, and explains the laws and properties of reflection, chiefly founded upon this truth, that the angle of reflection is always equal to the angle of incidence; and from thence deducing the magnitudes, shapes, and situations of the appearances of objects seen by the reflection of polished surfaces, and particularly plane, spherical, conical, and cylindrical ones. See OPTICS.

CAVALRY, a body of soldiers that charge on horseback, and may properly be called the right arm of the army: they are of great service in disturbing the enemy by their frequent excursions, in intercepting convoys, and destroying the country. The cavalry is divided into squadrons, and encamp on the wings of the army.

CAVEAR, CAVEER, or CAVIAR, the spawn or hard roes of sturgeon, made into small cakes, salted and dried in the sun. This sort of food is in great repute throughout Muscovy.

CAVIA, a genus of the order of glires. The animals of the genus cavia live on vegetable substances, and inhabit excavations under ground, or beneath the roots of trees. The principal of the genus are,

1. Cavia cobaya, the variegated cavy, or Guinea pig. This little animal is very easily rendered tame, but is seldom observed to shew any attachment to its benefactors; and is not distinguished by any remarkable degree of docility: it is, however, cleanly, harmless, and of a timid disposition.

2. Cavia paca or spotted cavy, is a native of South America and inhabits holes near the banks of rivers. It resembles a pig, and has been called the hog rabbit. The South Americans prize it as an article of food. 3. Cavia capybara. This species was considered by Linnæus as a kind of hog, and called by him sus-hydrochæris. It grows to a large size and inhabits Brasil, where it feeds on sugar canes and fish. 4. Cavia caudati aguti. This species is common in Guiana, and is of the size of a rabbit, but its motion resembles that of a hare. It burrows in the woods, and sometimes lives in hollow trees, feeding on roots, fruits, &c. [illegible] Cavia aguti leprone, the leporine cavy, seems to be a variety of the preceding. It is a native of Surinam and is about the size of a hare. 6. Cavia acuschy is smaller than the aguti and of an olive colour. It is also a native of South America. 7. Cavia aperea, or rock cavy, is a native of Brazil and partakes of the qualities of the rabbit and the rat. The colour is that of the hare, and the belly is white.

CAUKING, or CAULKING OF A SHIP, is driving oakum, or the like, into all the seams of the planks of a ship, to prevent leaking and

keep out the water. After the seams are stopped they are done over with a mixture of tallow, pitch, and tar, as low as the ship draws water.

CAULICOLES, or CAULICOLI, are eight stalks, in the Corinthian capital, springing out from four greater or principal cauls, or stalks.

CAULIFEROUS, an appellation given to such plants as have a perfect caulis or stem.

CAULIFLOWERS. See BRASSICA.

CAUSTIC *(lunar.)* Fused nitrate of silver. See SILVER.

CAUSTICITY. All substances which have so strong a tendency to combine with the principles of organized substances as to destroy their texture, are said to be caustic. The chief of these are the concentrated acids, pure alkalis, and the metallic salts.

CAUSTIC *curve*, in the higher geometry, a curve formed by the concourse or coincidence of the rays of light, reflected from some other curve.

CAUTERY, a medicine for burning, eating, or corroding, any solid part of the body.

CAZEMATE, or CASEMATE, in fortification, a certain retired platform in the flank of a bastion, for the defence of the moat and face of the opposite bastion.

CEANOTHUS, NEW JERSEY TEA, a genus of the monogynia order, in the pentandria class of plants; and in the natural method ranking under the 43d order, dumosæ. There are six species, of which the most remarkable is the ceanothus Americanus, a native of most parts of North America. In England this plant seldom rises more than three feet high. The flowers grow at the ends of the twigs in clusters.

CECROPIA, a genus of the diandria order, in the diœcia class of plants; and in the natural method ranking under the 53d order, scabridæ. There is one species, a tree of South America.

CEDAR. See JUNIPERUS, and PINUS.

CEDAR, *bastard.* See THEOBROMA.

CEDAR, *white.* See CUPRESSUS.

CEDRELA, a genus of the monogynia order, in the pentandria class of plants; and ranking, according to the natural method, under the 54th order, miscellaneæ. There is only one species, called Barbadoes bastard cedar.

CELASTRUS, the STAFF TREE, a genus of the monogynia order, in the pentandria class of plants; and in the natural method ranking under the 43d order, dumosæ. There are 22 species, two of which are inured to our climate, viz. 1. Celastrus bullatus, an uncertain deciduous shrub, a native of Virginia. It is about four feet high. The flowers are produced in July, at the ends of the branches, in loose spikes. They are of a white colour, and are succeeded by beautiful scarlet fruit. 2. Celastrus scandens, the flowers of which are green, and appear in June. The berries are red, and make a fine appearance in autumn.

CELERY. See APIUM.

CELOSIA, COCK'S-COMB, a genus of the monogynia order, in the pentandria class of plants; and in the natural method ranking under the 54th order, miscellaneæ. There are 14 species, the principal of which is, Celosia cristata, or common cock's-comb. The principal colours of its flowers are red, purple, yellow, and white; but there are some whose heads are variegated with two or three colours.

CELSIA, a genus of the angiospermia order, in the didynamia class of plants; and in the natural method ranking under the 28th order, luridæ. The calyx is quinquepartite; the corolla wheel-shaped; the filaments bearded or woolly; the capsule bilocular. There are four species, natives of Armenia.

CELTIS, the LOTE, or *nettle-tree*, a genus of the monœcia order, in the polygamia class of plants; and in the natural method ranking under the 53d order, scabridæ. It is an hermaphrodite plant. There are seven species, all of them deciduous. The most remarkable are 1. Celtis australis, the southern celtis, a native of Africa and the south of Europe. 2. Celtis occidentalis, the western celtis, a native of Virginia. 3. Celtis orientalis, the eastern celtis, a native of Armenia: it grows to about 12 feet. The flowers come out from the wings of the leaves; they are yellowish, appear early in the spring, and are succeeded by large yellow fruit.

CEMENT, a term used to denote whatever is employed to unite together things either of the same or of different kinds. In this sense it includes lutes, glues, and also solders of every kind; but it is more commonly employed to signify those of which the basis is an earth or earthy salt. The following are some of the cements used for particular purposes.

For Derbyshire Spar.

A cement for this purpose may be made with about seven or eight parts of resin and one of bees'-wax, melted together with a small quantity of plaster of Paris. When the ingredients are well mixed, and the whole is nearly cold, the mass should be well kneaded together. The pieces to be joined, must be heated until they will melt the cement, and then pressed together, some of the cement being previously interposed.

Jeweller's Cement.

For setting precious stones, when pieces are broken off by accident. In such cases the artist can frequently join the pieces so correctly that an inexperienced eye cannot discover the fracture; for this purpose a small piece of gum mastich is applied between the fragments which are previously heated sufficiently to melt the interposed gum.

A Cement for China, Glass, &c.

Take quick-lime and white of eggs, or old thick varnish; grind and temper them well together, and it is ready for use. Drying oil and white lead are also frequently used for cementing China and earthenware; but this cement requires a long time to dry. Where it is not necessary the vessel should endure heat or moisture, isinglass glue, with a little tripoli, or chalk, is better.

A Cement for Iron joints that will resist boiling water and steam.

Take two ounces of muriate of ammonia, one of flowers of sulphur, and sixteen of cast iron borings. Let them be well mixed in a mortar, and keep the powder dry. When the cement is wanted for use, take one part of

this mixture, twenty parts of clean iron borings, grind them together in a mortar, mix them with water to a proper consistence, and apply them between the joints. In a short time this cement unites with the iron into one mass.

Six parts of clay, one of iron filings, and linseed oil sufficient to form a thick paste, make a good cement for stopping cracks in iron boilers.

Temporary Cements for Glass-grinders, Lapidaries, &c.

Take pitch and boil it; add thereto, and keep stirring it all the while, fine sifted wood ashes, until you have it of a proper temper: a little tallow may be added, if necessary. For small work: to four ounces of resin add one-fourth of an ounce of bees-wax melted together; and four ounces of whiting, made previously red hot.

Shell-lac is a very strong cement for holding metals, glass, or precious stones, while cutting, turning, or grinding them. The metal, &c. should be warmed, to melt it.

A Cement for Electrical apparatus.

Five pounds of resin, one of bees-wax, one of red ochre, melted together, to which may be added about two table spoonsful of plaster of Paris, observing to mix the whole mass most intimately. A cheaper one for voltaic purposes is made of six pounds of resin, one of red ochre, half a pound of plaster of Paris, and a quarter of a pint of linseed oil. The ochre and plaster should be well dried, and added to the other ingredients when they are thoroughly melted.

Japanese Cement.

This elegant cement is made by mixing rice flour with cold water, and then gently boiling it. It is beautifully white, and when dry is almost transparent. This cement is used for joining the parts of all curious paper articles.

CENCHRUS, in botany, a genus of the polygamia monoecia class of plants. There are two flowers, the one male, the other hermaphrodite. There are 11 species.

CENSOR *of books*, a body of doctors or others established in divers countries to examine all books before they go to the press, and to see they contain nothing contrary to faith and good manners.

CENSUS, in Roman antiquity, an authentic declaration made before the censors, by the several subjects of the empire, of their respective names and places of abode.

CENT., in commerce, an abridgement of centum, is used to express the profit or loss arising from the sale of any commodity: thus we say, there is 10 *per cent.* profit, or 10 *per cent.* loss; which is $\frac{1}{10}$th profit, or $\frac{1}{10}$th loss, upon the sale of the whole.

CENTAUREA, a genus of the polygamia frustranea order, in the syngenesia class of plants, and in the natural method ranking under the 49th order, compositæ. There are 77 species, of which we shall only mention two, viz. 1. Centaurea cyanus, the bluebottle, grows commonly among corn. The juice of this flower stains linen of a beautiful blue colour, but it is not permanent without the addition of alum. 2. Centaurea glastifolia. The root of this species is an article in the materia medica.

CENTER, or CENTRE, a point equally distant from the extremities of a line, figure, or body.

CENTER *of a bastion*, a point in the middle of the gorge of a bastion, whence the capital line commences, and is generally at the angle of the inner polygon.

CENTER *of a conic section*, a point in which the diameters intersect each other.

CENTER *of a curve of the higher kind*, the point where two diameters concur. When all the diameters concur in the same point, Sir Isaac Newton calls it the general center.

CENTER *of a dial*, that point where the axis of the world intersects the plane of the dial; and also that point wherein all the hour-lines meet.

CENTER *of gravity*, in mechanics, that point about which all the parts of a body, in any situation, balance each other.

CENTER *of oscillation*, that point in a pendulum in which, if the weight of the several parts was collected, each vibration would be performed in the same time as when those weights are separate. The center of suspension is the point on which the pendulum hangs.

CENTER *of percussion*, in a moving body, that point wherein the percutient force is greatest.

CENTINEL or CENTRY, is a private soldier, from the guard posted upon any spot of ground, to stand and watch carefully for the security of the said guard, or of any body of troops, or post, and to prevent any surprise from the enemy.

CENTRAL *forces*, the powers which cause a moving body to tend towards, or recede from, the center of motion.

CENTRIFUGAL *force*, that by which all bodies that move round any other body, in a curve, endeavour to fly off from the axis of their motion in a tangent to the periphery of the curve, and that in every point of it.

CENTRIPETAL *force*, that force by which a body is everywhere impelled, or tends towards some point as a center; such are gravity, or that force whereby bodies tend towards the center of the earth; magnetical attraction, whereby the loadstone draws iron; and that force, whatever it be, whereby the planets are continually drawn back from right-lined motions, and made to move in curves.

CENTRISCUS, in ichthyology, a genus of fishes belonging to the order of amphibianantes. There are two species. 1. The scutatus, which has its back covered with a smooth bony shell, which ends in a sharp spine, under which is the tail, but the back fins are between the tail and the spine. It is a native of the East Indies. 2. The scolopax, has a rough scabro[illegible] body, and a straight extended tail. It has two belly-fins, with four rays each, and has no teeth. It is found in the Mediterranean.

CENTUNCULUS, a genus of plants called by some *anagallidiastrum*, and by others a species of *anagallis*. It belongs to the tetrandria monogynia class of plants; the flower is monopetalous, the tube globose, and the limb divided into four oval segments: the fruit is an unilocular capsule, containing several roundish seeds. There is one species, annual.

CENTURION, among the Romans, an

officer in the infantry, who commanded a century or a hundred men.

CEPHALANTHUS, a genus of the tetrandria monogynia class of plants: the corolla a single petal, the tube slender; the limb divided into four parts; the fruit an oblong capsule, containing only one cell; the seeds are numerous and oblong. There are five species, trees and shrubs of China.

CEPHALIC *medicines*, are remedies for disorders of the head.

CEPHALIC *vein*. See ANATOMY.

CERAMBYX, a genus of beetles, the characters of which are; the antennæ long and setaceous; the thorax oblong, rounded, and pointed at each extremity. Under this genus is comprehended the capricorn-beetle. There are 83 species.

CERASTIUM, MOUSE-EAR, a genus of the decandria pentagynia class of plants, the flower of which consists of five bifid petals; and its fruit is a very long unilocular pod, containing numerous roundish seeds. There are 18 species of this weed.

CERATE, in pharmacy, a medicine used externally in several diseases, especially those of the skin. It is generally of four sorts, the white, the yellow, the cicatrizing, and the mercurial cerate.

CERATOCARPUS, a genus of the monœcia monandria class of plants, having no petals, and a small, compressed, bicornate seed, not unlike that of bidens.

CERATONIA, the CAROB TREE, or *St. John's Bread*, a genus of the triœcia order, in the polygamia class of plants, and in the natural method ranking under the 33d order, lomentaceæ. The calyx is hermaphrodite and quinquepartite; there is no corolla; the stamina are five; the style is filiform; the legumen coriaceous and polyspermous. It is also diœcious, or male and female distinct on different plants. There is but one species, viz. Ceratonia siliqua, a native of Spain, of some parts of Italy, and the Levant. It is an evergreen, and grows in the hedges.

CERATOPHYLLUM, a genus of the polyandria order, in the monœcia class of plants, and in the natural method ranking under the 15th order, inundatæ. There are two species, of no note.

CERBERA, a genus of the monogynia order, in the pentandria class of plants, and in the natural method ranking under the 30th order, contortæ. The fruit is a monospermous plum. Of five, the most remarkable species is, Cerbera atrouai, a native of the warm parts of America.

CERCELE, in heraldry. A cross cercele is a cross which, opening at the ends, turns round both ways like a ram's horn.

CERCIS, the JUDAS TREE, a genus of the monogynia order, in the decandria class of plants, and in the natural method ranking under the 33d order, lomentaceæ. There are only two species, both deciduous. The most remarkable is, Cercis Canadensis, or Canadian cercis: it will grow to the height of twenty feet in some places. The flowers are often eaten in sallads, and afford an excellent pickle.

CEREBELLUM, in anatomy, the hinder part of the brain. See ANATOMY.

CEREBRUM. See ANATOMY.

CERINTHE, HONEY WORT, a genus of the monogynia order, in the pentandria class of plants, and in the natural method ranking under the 41st order, asperifoliæ. There are two species, natives of Germany, Italy, and the Alps. They are low annual plants, with purple, yellow, and red flowers.

CERIUM, a new metal obtained from a fossil found in Sweden, to which has been given the name of Cerite. This fossil occurs disseminated or massive; it is of a flesh red colour, more or less deep, with sometimes a shade of yellow: it is semi-transparent: its fresh fracture has considerable lustre. It strikes fire with steel with difficulty: is not attracted by the magnet: its specific gravity is from 4.7 to 4.9. Exposed to a strong heat it does not melt, but loses 5 or 6 per cent. of weight, becomes friable, and acquires a bright yellow colour.

CERTHIA, the creeper, or ox-eye, a genus of birds belonging to the order of picæ. There are 50 species, the principal of which are, 1. The familiaris, or common ox-eye, which is grey above and white below with brown wings, and white spots on the prime feathers. This bird is common in our island and runs with great facility on the bark of a tree. Its food is chiefly insects, the eggs, which are generally five, are ash-coloured. 2. The hook-billed green creeper is a native of the Sandwich islands. The inhabitants of which make use of its feathers to form their ornamental dresses 3. The pusila is of a brown colour with a gloss of copper, and white beneath. It is a native of the Cape of Good Hope, and fond of honey 4. The Loteni, or Loten's creeper, has the upper parts of a green gold colour. This elegant bird inhabits Ceylon and Madagascar 5. The cerulea or blue creeper, has the head of a fine blue, and on each side a stripe of black in which the eyes are seated; the rest of the body is a violet blue, except the chin and throat, which are black. Its nest resembles a retort and the neck is a foot long. 6. The sannio or mocking creeper, is about the size of a thrush. The head is inclined to a violet colour, and the general plumage is olive green. It is an inhabitant of New Zealand, it has the faculty of imitating the notes of other birds.

CERTIORARI, an original writ, issuing out of the court of chancery or the king's bench, directed to the inferior courts, commanding them to certify or to return the records of a cause depending before them, to the end the party may have the more sure and speedy justice before the king or such justices as he shall assign to determine the cause.

CERVICAL *nerves*, in anatomy, are eight pair of nerves, so called as having their origin in the neck.

CERUMEN, is a viscid yellow-coloured liquid secreted by the glands of the auditory canal, which gradually becomes concrete by exposure to the air. It has an orange-yellow colour and a bitter taste. When slightly heated upon paper, it melts, and stains the paper like an oil; at the same time it emits a slightly aromatic odour.

CERUSE, or CERUSS, white-lead, a sort of calx of lead, made by exposing plates of that metal to the vapour of vinegar

CERVUS, the STAG OR DEER-KIND, in zoology, a genus of quadrupeds of the order of the pecora. The generic character is: horns

solid, covered while young with a hairy skin, growing from the top, naked, annual, branched. Front teeth in the lower jaw, eight. Canine teeth, none; sometimes single in the upper jaw.

The following are the most remarkable species. 1. Cervus alces, or elk. This is the largest of the genus, and when full grown is about the size of a horse. The neck is short and thick; the head large, the horns spreading into a broad palmated form. It is an inoffensive animal and feeds on the boughs of trees. The female has no horns. In Europe the elk is chiefly found in Sweden, Norway, and Russia: and the largest are in Siberia. In America they are most common in Canada, where they are called moose-deer. 2. Cervus tarandus or reindeer, is an inhabitant of the northern regions, chiefly in Norway, Lapland, Greenland, and in Siberia. The height is about five feet, and the legs are shorter in proportion than those of the stag. The general colour is brown above, and white beneath; but, as it grows older, it becomes of a grey-white. The horns are long and slender, and they besides have a pair of brow antlers with tips which expand forwards. The Laplanders use this animal for various purposes. 3. Cervus elaphus or stag, is of an elegant figure. It varies in different climates both in size and colour; the general height is three feet and a half, and the colour a reddish brown. The usual number of branches in the horns of a well grown stag are six or seven. It generally casts or sheds its horns in March, and at the end of June they are full grown. 4. Cervus dama, or fallow deer, is smaller than the stag, and of a brown-bay colour and whitish beneath. 5. Cervus Virginianus, Virginian deer, is a native of North America, where it associates with its own tribe in great numbers. In size it resembles the fallow deer, and the colour is a light brown. 6. Cervus axis, or spotted axis, is a beautiful species, about the size of the fallow deer, and in colour a light rufous brown, marked with white spots. It is an eastern animal. 7. The middle axis; this appears to be only a variety of the preceding, and is in size between the spotted axis and the great axis. The colour is the same as the former, but without spots. It is a native of Ceylon, Borneo, Celebes, and Java. 8. Great axis. The existence of this variety is ascertained by a pair of horns in the British Museum, which measure two feet nine inches in length. It is supposed they were brought from Ceylon or Borneo. 9. Cervus pygargus, or tailless roe is a native of Russia and Siberia. It resembles the roebuck, but is larger, and, instead of a tail, has a broad cutaneous excrescence. 10. Cervus Mexicanus, or Mexican roe, is of a reddish colour spotted with white. 11. Cervus porcinius, or porcine deer, has slender horns, thirteen inches long: the height of the animal is two feet two inches; the body thick and the colour brown. 12. Cervus capreolus, or common roe, is of a reddish brown colour, three feet nine inches long, height 2 feet 7 inches, and the length of the horns six or eight inches. It is an inhabitant of Europe and Asia. 13. Cervus muntjac, or rib-faced deer, is a native of Java and Ceylon. It is less than the roebuck, and what principally distinguishes it is the appearance of three longitudinal subcutaneous ribs, extending from the horns to the eyes. A tusk depends from each side of the upper jaw. 14. Cervus guinensis, or grey deer, is of the size of a cat, and of a grey colour interspersed with black spots and lines. It is a native of Africa.

CESARE, among logicians, one of the modes of the second figure of syllogisms; the minor proposition of which is a universal affirmative, and the other two universal negatives.

CESTRUM, BASTARD JASMINE, a genus of the monogynia order, in the pentandria class of plants, in the natural method ranking under 28th order luridæ. The corolla is funnel-shaped; the stamina sending out a little tooth about the middle. There are six species, all natives of the warmest parts of America; so cannot be preserved in this country without artificial heat. They are flowering shrubs, rising in height from five to twelve feet, with flowers of a white, or pale yellow colour.

CETUS, in astronomy, a constellation of the southern hemisphere, comprehending twenty-two stars in Ptolemy's Catalogue, twenty-one in Tycho's, and in the Britannic Catalogue ninety-seven.

In this constellation is a variable star which appears and disappears periodically.

CETE, the seventh order in the mammalia class of animals; the characters of which are, breathing apertures on the head, tail horizontal, no claws. The animals of this order are all of the whale kind.

Cetaceous fish, like land-animals, breathe by means of lungs, being destitute of gills. This obliges them to rise frequently on the surface of the water to respire. They have the power of uttering sounds; and like land-animals, they suckle their young.

CHÆROPHYLLUM, CHERVIL: a genus of the digynia order, in the pentandria class of plants; and in the natural method ranking under the 45th order, umbellatæ. There are ten species, two of which, called cow-weed and wild chervil, are weeds common in many places in Britain. The roots of the first are poisonous; the flowers afford an indifferent yellow dye; the leaves and stalks a beautiful green.

CHÆTODON, a genus of fishes belonging to the order of thoracici. The teeth are very numerous, thick, setaceous, and flexile; the rays of the gills are six. The back fin and the fin at the anus are fleshy and squamous. There are 23 species. The most remarkable is the acuminatus, or shooting fish, having a hollow cylindrical beak. It is a native of the East Indies

CHAFF, in agriculture, the husky substance of corn separated from the grain after threshing by the process of winnowing, it also signifies the rind of corn, and likewise straw cut small for the use of cattle.

CHAIN, a series of several rings, or links fitted into one another. Chains are made of various metals, sizes, and forms, for different uses. A gold chain is one of the badges of dignity of the Lord Mayor of London. It is also the badge of office of the Sheriff, but only while in office.

CHAINS, in a ship, those irons to which the shrouds of the masts are made fast to the chain walls.

Chain *shot*, two bullets with a chain between them. They are used at sea to shoot down yards or masts, and to cut the shrouds or rigging of a ship.

Chain *pump*. See Pump.

Chain, in surveying, a measure of length, made of a certain number of links of iron-wire, serving to take the distance between two or more places. Gunter's chain is of 100 such links, each measuring 7$\frac{92}{100}$ inches, and consequently equal to 66 feet, or four poles.

CHAINWORK, is a term applied to those articles of manufacture in which any kind of cordage or thread is linked together in the form of a chain. This term of course includes the process of tambouring; all the varieties of lace manufacture, hosiery, net-making, &c.

CHALCEDONY, in natural history, a genus of semi-pellucid gems, of an even texture, and a semi-opaque and crystalline basis, variegated with different colours. Of this genus there are a great many species, as the bluish white, the brownish black, and the yellow and red chalcedony.

This stone is found in many countries, particularly in Iceland and the Ferro islands. When striped white and black, or brown alternately, it is called *onyx;* when white and grey, *chalcedonix.*

CHALDRON, a dry measure, consisting of thirty-six bushels, heaped up, but on shipboard, twenty-one chaldron of coals are allowed to the score. The chaldron should weigh two thousand pounds.

CHALK. A very common species of calcareous earth, of an opaque white colour, very soft, and without the least appearance of a polish in its fracture. It contains a little siliceous earth, and about two per cent. of clay. Some specimens, and perhaps most, contain a little iron.

Chalk (*black*). Drawing slate. The colour of this mineral is greyish or bluish-black. Massive. The principal fracture is glimmering and slaty, the cross fracture dull, and fine earthy. It is in opaque, tabular fragments, stains paper black, streak glistening, and the same colour as the surface; easily cut and broken.

CHALLENGE, in law, is an exception made by the party put on his trial to jurors, either in civil or criminal causes. In cases of treason, the prisoner may challenge to the number of twenty-five, but in murder and other felonies only twenty.

CHALYBEATE, a term used to denote mineral waters which are impregnated with iron.

CHAMÆROPS, the dwarf palm, or little palmetto, in botany, a genus of the natural order of palmæ. Hermaphrodite calyx tripartite; corolla tripetalous: stamina six; pistils three, and three monospermous plums. The male is a distinct plant, and also the hermaphrodite. Of the three species the principal is the chamærops glabra, a native of the West Indies, Asia, and Africa. The leaves are broad and spread like a fan. They are used to cover huts with in some countries.

CHAMBERLAIN, an officer charged with the management and direction of a chamber.

There are almost as many kinds of chamberlains as chambers, the principal of which are as follow:

Chamberlain, *Lord, of great Britain*, the sixth great officer of the crown; to whom belongs livery and lodging in the king's court; and there are certain fees due to him from each archbishop or bishop when they perform their homage to the king: and from all peers at their creation, on doing their homage. This office is hereditary.

Chamberlain, *Lord of the Household*, an officer who has the oversight and direction of all the officers belonging to the King's chambers, except the precinct of the king's bed chamber.

Chamberlain of *London*, keeps the city money, which is laid up in the chamber of London: he also presides over the affairs of masters and apprentices, and makes free of the city, &c. His office lasts only one year; but the same person is usually re-chosen, unless charged with any misdemeanor in the management of the affairs of his office.

CHANCE, is more particularly used for the probability of an event; and is greater, or less, according to the number of chances by which it may happen, compared with the number of chances by which it may either happen or fail. Thus, if an event has three chances to happen, and two to fail, the probability of its happening may be estimated $\frac{3}{5}$, and the probability of its failing $\frac{2}{5}$. Therefore, if the probabilities are added together, the sum will be equal to unity.

If the probabilities are unequal, there are odds for, or against, the happening or failing, which odds are proportional to the number of chances for happening or failing.

The expectation of obtaining any thing is estimated by the value of that thing, multiplied by the probability of obtaining it. The risk of losing any thing is estimated by the value of that thing, multiplied by the probability of losing it. If, from the expectations which the gamesters have upon the whole sum deposited, the sums they deposit are subtracted, there will remain the gain, if the difference is positive; or the loss, if it is negative. Again, if from the respective expectations which either gamester has upon the sum deposited by his adversary, the risk of losing what he himself deposits is subtracted, there will likewise remain his gain or loss.

If there is a certain number of chances by which the possession of a sum can be secured, and a certain number by which it may be lost, that sum may be insured for that part of it, which shall be to the whole, as the number of chances there are to lose is to the number of all the chances.

If two events have no dependence on each other, so that p be the number of chances by which the first may happen, and q the number of chances by which it may fail: and likewise, that r be the number of chances by which the second may happen, and s the number of chances by which it may fail: multiply $p+q$ by $r+s$, and the product $pr+qr+ps+qs$ will contain all the chances by which the happening or failing of the events may be varied among one another.

Hence it follows, that if a fraction expresses the probability of an event, and another frac

tion the probability of another event, and these two events are independent, the probability that these two events will happen, will be the product of the two fractions.

CHANCELLOR, an officer supposed originally to have been a notary or scribe under the emperors; and named cancellarius, because he sat behind a lattice, called cancellus, to avoid being crowded by the people.

Lord high chancellor of Great Britain, or lord keeper of the great seal, is the highest honour of the long robe; he is the first person of the realm next after the king, and princes of the blood, in all civil affairs; and is the chief administrator of justice next the sovereign, being the judge of the court of chancery, which is styled a court of equity. The jurisdiction of this court is of vast extent. Almost all causes of weight and moment, first or last, have their determination here. This court will not retain a suit for any thing under 10*l.* value, except in cases of charity, nor for lands under 40*s.* per annum.

Chancellor *of the exchequer*, an officer who presides in that court, and takes care of the interest of the crown. He is always in commission with the lord treasurer, for the letting of crown lands, &c. and has power, with others, to compound for forfeitures of lands, upon penal statutes: he has also great authority in managing the royal revenues, and national finances.

Chancellor *of the order of the garter*, is an officer who seals the commissions and mandates of the chapter; keeps the register of their proceedings; and delivers acts thereof under the seal of their order.

Chancellor *of an university*, is he who seals the diplomas, or letters of degrees, provision, &c. given in the university.

The chancellor of Oxford is usually one of the prime nobility, chosen by the members of the university in convocation.

CHANCERY, the grand court of equity and conscience, instituted to moderate the rigour of the other courts that are bound to the strict letter of the law.

CHANNEL, in hydrography, the deepest part of a river, harbour, strait, &c. which is most convenient for the track of shipping; also an arm of the sea running between an island and the main or continent, as the British Channel.

CHAOS, in zoology, a genus of insects belonging to the order of zoophyta. The body has no covering, and is capable of reviving after appearing to be dead for a considerable time. It has no joints, or external organs of sensation. There are five species, mostly obtained by infusions of different vegetables in water, and only discoverable by the microscope.

CHARACTER, in a general sense, denotes any mark whatever, serving to represent either things or ideas; thus, letters are characters, types, or marks of certain sounds, words, or ideas, &c.

Character is also used in several of the arts, for a symbol, contrived for the more concise and immediate conveyance of the knowledge of things.

CHARADRIUS, in ornithology, a genus belonging to the order of grallæ. Among the species, of which there are 27 or 28, are,

1. The Alexandrius, or Alexandrian dottrel, is of a brownish colour, with the forehead, collar, and belly white; the prime tail feathers are white; and the legs are black. It is about the size of a lark, and lives upon insects.

2. The Ægyptius has a black streak on the breast, white eye-brows, the prime tail feathers streaked with black at the points, and blueish legs. It is principally found in the plains of Egypt.

3. The morinellus has an iron-coloured breast, a small white streak on the breast and eye-brows, and black legs. It is found in Cambridgeshire, Lincolnshire, and Derbyshire.

4. The pluvialis is black above, with green spots, white underneath, and the feet are ash-coloured, It is the green plover of Ray, and is a native of Europe

5. The œdicnemus, or stone curlew of Ray, is of a grey colour, with two of the prime wing-feathers black, but white in the middle it has a sharp bill, and ash-coloured feet; and is about the size of a crow. In Hampshire, Norfolk, and Lincoln, it is called the curlew, from a similarity of colours to the curlew These birds feed in the night on worms and caterpillars: they will also eat toads, and catch mice.

CHARCOAL is wood burnt through, and suddenly extinguished by being covered with fresh earth. It is perhaps one of the most durable substances with which we are acquainted, not being decomposed either by the air or the water.

The chief use to which charcoal is applied is fuel, but it is also employed as a tooth powder, to purify tainted meat and water. For the first process no mode of preparation is necessary, and for the others it is sufficient to reduce it to a powder. It forms an indispensable constituent in the manufacture of gunpowder.

CHARGE, in gunnery, the quantity of gunpowder and ball wherewith a gun is loaded. The rules for charging large pieces in war are, that the piece be first cleaned or scoured within side; that the proper quantity of powder be next driven in and rammed down: care being taken, that the powder in ramming be not bruised, because that weakens its effect; that a little quantity of paper, hay, lint, or the like, be rammed over it: and that the ball or shot be intruded. If the ball be red-hot, a tampion, or trencher of green wood is to be driven in before it. The weight of the powder necessary for a charge is commonly in a subduple proportion to that of the ball.

Charge, in heraldry, is applied to the figures represented on the escutcheon, by which the bearers are distinguished from one another.

CHART, or hydrographical map, is a representation of a part, or the whole of the water on the surface of the earth in plano. See the article Map.

CHARTA, *magna*, an ancient instrument, containing several privileges and liberties granted to the church and state by Edward the Confessor together with others relating to

the feudal laws of William the Conqueror, granted by Henry I. all confirmed by the succeeding princes.

CHECK, or *check roll*, a book containing the names of such persons as are attendants and in pay to the king, or other great personages.

Clerk of the **Check**, in the king's household, has the check and control of the yeomen of the guard, and all the ushers belonging to the royal family.

Checks, or *drafts*, on bankers, are bills made payable to the bearer by those who hold money in the banker's hands. They are equally negotiable with bills, although, strictly speaking, not due before payment is demanded. Checks ought to be presented for payment on the day they are received.

CHECKY, in heraldry, is when the shield, or a part thereof, as a bordure, &c. is divided into chequers or squares.

CHEEKS, among mechanics, are those pieces of machines that are double, and perfectly alike.

Cheeks, in ship-building, two pieces of timber, fitted on each side of the mast, at the top, serving to strengthen the mast there, and having holes in them, called hounds, through which the ties run to hoist the yards. Also the uppermost rail, or piece of timber in the beak of a ship.

CHEIRANTHUS, *stock gilliflower*, and *wallflower:* a genus of the 39th natural order, siliquosæ, and belonging to the tetradynamia class of plants. There are 22 species, of which the following are most worthy of notice.

1. Cheiranthus annuus, or ten weeks' stock, with an upright, woody, smooth stalk, divided into a branchy head, with spear-shaped leaves, and all the branches terminated by numerous flowers, of different colours in different varieties.

2. Cheiranthus cheiri, or the common wallflower, &c.

3. Cheiranthus incanus, the hoary cheiranthus grows from one to two or three feet high, of different colours in different varieties. The two last sorts are very hardy evergreen biennials or perennials; but the first must be continued by seed sown every year.

CHEKAO, a kind of paste, prepared by calcination and trituration from a hard stony substance. The Chinese use the chekao in drawing the elegant figures we see in the wholly white China ware, which they afterwards varnish in the common way.

CHELIDONIUM, *celandine*, *horned* or *prickly poppy:* a genus of the monogynia order, in the pentandria class of plants; and in the natural method ranking under the 27th order, rhœadeæ. The corolla is tetrapetalous, the calyx diphyllous, the siliqua unilocular and linear. There are five species. One of them, viz. chelidonium majus, grows on old walls, among rubbish, and in waste shady places. It is of a bluish green colour; the root of a deep red; and both contain a gold-coloured juice. The juice takes off warts; and cures tetters, ring-worms, and the itch.

CHELONE, in botany, a genus of the angiospermia order, in the didynamia class of plants; and in the natural method ranking under the 40th order, personatæ. There are five species, all natives of North America.

CHEMISTRY is the science which investigates the composition of material substances, and the permanent changes of constitution which their mutual actions produce.

In no science does modern improvement appear so conspicuous; and in none can it boast of so extensive utility as in chemistry. Such, indeed, is the present state of chemical science, that it might be pronounced perfect, were it not that the progress which it is making at the present hour, seems to point out the absurdity of attempting to circumscribe it within any limits whatever.

Writers on this subject vary from each other considerably with regard to the order in which they treat its different parts. In the earlier works on chemistry, the operative part usually precedes the theoretical. Some writers treat of compound bodies, and deduce their component parts in the way of analysis; while others begin with the habitudes or powers by which the several changes are effected. But it must be acknowledged that every one of the phenomena of chemistry is, notwithstanding the brilliant discoveries already made, still sufficiently complicated to render it referrable to various topics of consideration; so that, generally speaking, it is a matter of little moment to which of these our attention is first directed. Without, therefore, deciding as to the respective merits of these different methods of procedure we shall, in the following brief outline, adopt that which to us appears the most natural, commencing with the *simple substances.*

By simple substances, in a chemical sense, are to be understood those bodies which have not hitherto been decompounded. Many substances, denominated simple by the old chemists, have been, by the moderns, clearly ascertained to be compounds; such, for instance, is atmospheric air; and such also is water. Several substances also, which, but a few years ago, were considered as simple, have been decomposed by Sir H. Davy, and their component parts satisfactorily exhibited to the senses; of this description are the alkalis and earths.

SIMPLE SUBSTANCES.

These may be said to be, 1. *Simple supporters of combustion.* 2. *Simple combustibles.* 3. *Simple incombustibles.* 4. *Metals.*

SIMPLE SUPPORTERS OF COMBUSTION.

1. Oxygen. This substance is so named from two Greek words which signify the production of acid, as one of its properties is the formation of acids by combining with different substances, termed the bases of the acids. Oxygen is one of the most important agents in nature; there is hardly any process, natural or artificial, in which it has not a share. The principal sources whence it is obtained are air and water: in air it is combined with nearly one third of its weight of hydrogen: in water it is united with azotic, or nitrogen gas, and forms about ⅕ of the atmosphere, the other ⅘ths are nitrogen.

It is, however, obtained in the greatest abundance by submitting the black oxide of manganese to a red heat in an iron retort; almost all the metallic oxides will give out oxygen; but when it is wanted in a state of great

purity it should be obtained from oxymuriate of potash.

Oxygen gas possesses the mechanical properties of common air: it is termed a supporter of combustion, because although not inflammable itself, it is the most powerful supporter of combustion.

2. *Chlorine.* This substance was first discovered by Scheele, who called it *dephlogisticated muriatic acid.*

Like oxygen, it has an affinity for a great number of bodies, and uniting with them, forms compounds of a peculiar nature; it has been found by the experiments of Sir H. Davy to be destitute of oxygen, and yet is in some respects a more powerful supporter of combustion than oxygen itself. Chlorine is obtained by distilling a mixture of black oxide of manganese with muriatic acid. When this mixture is heated, a green coloured gas rises from it, which may be collected in the common way over water. Several substances, as phosphorus, antimony, &c. take fire of their own accord when plunged into this gas. The term chlorine was assigned to it by Sir H. Davy as descriptive of its colour.

SIMPLE COMBUSTIBLES

1. *Hydrogen,* which like oxygen, is a gas, and was first called inflammable air: its discovery belongs to Mr. Cavendish. It is the lightest of all gaseous bodies; is colourless, invisible, and possesses the mechanical properties of air. Hydrogen may be obtained by putting some clean iron-filings or small chippings into a glass retort, and pouring over them sulphuric acid diluted with thrice its bulk of water. A violent effervescence instantly takes place; gas issues in abundance from the beak of the retort, which may be received over water. This gas, although combustible when in contact with atmospheric air, extinguishes a taper, or even lighted phosphorus when immersed in it. Its specific gravity is 0.0694; and from its great levity it is used for inflating baloons

2. *Carbon,* in its purest form, is known only in the *diamond;* but it may be procured in a state of *charcoal* by burning a piece of wood covered with sand, in a crucible. Charcoal, the combination with which we are the most familiar, is the coaly residuum of any vegetable that has been burned in close vessels. It is generally black, sonorous, brittle, very light, and destitute of taste or smell. Charcoal is a powerful antiseptic, has great affinity for oxygen, is unalterable and indestructible by age, and, if air and moisture be excluded, is not affected by the most intense heat.

Phosphorus. This substance is obtained by pouring acetate of lead into urine, and distilling the white powder which precipitates, with some charcoal, in an earthen retort, by means of a strong heat. The beak of the retort must be inserted in water; the phosphorus will drop into the water like melted wax. Phosphorus, when pure, is semi-transparent; of a yellowish colour: it is soft, and may be cut with a knife. It melts at the temperature of 99°. When exposed to the air it emits a white smoke, which in the dark is luminous. It must be kept in phials of water, closely corked up. The compounds which phosphorus forms with other substances are denominated *phosphorets.*

4. *Sulphur.* This is one of those combustible substances which have the greatest tendency to combination. It is a hard brittle substance of a yellow colour, and with little taste. It is a non-conductor of electricity; and becomes electric *negatively* by friction. At the heat of 170° it rises up in the form of a fine white powder, well known by the name of flowers of sulphur.

5. *Boracium.* This substance was discovered by Sir H. Davy. To procure it, equal parts of the metal called potassium and dry boracic acid must, for a few minutes, be exposed in a copper-tube to a slight red heat. When cold, the mass must be washed out with water, and the potash saturated with muriatic acid, and the whole filtered. The matter which remains must be washed and dried, and this is *boracium.* It is of a dark olive colour, opaque, and brittle, and has some resemblance to charcoal.

SIMPLE INCOMBUSTIBLES.

The only substance under this head with which we are at present acquainted is *azote,* which is also called *nitrogen.* This gas is invisible; possesses the mechanical properties of air; it neither supports flame nor animal life, and although incombustible, it is capable of being combined with oxygen gas. It enters into combination with but few substances.

METALS.

Metals are distinguished by their peculiar lustre, called the metallic lustre: they are opaque, except gold, even in the thinnest plates to which they can be reduced. All the old metals are heavier than water; but some of the new metals discovered by Sir H. Davy are lighter than water. They are the best conductors of electricity known; they are all *soft,* although some of them have a capacity for great hardness, which may be artificially produced, as may also their elasticity. Some of them are *malleable,* while others are extremely *brittle;* some are *ductile,* and may be drawn into very fine wires, others are destitute of this property. Several of them take fire when heated, and burn with great splendour; and almost all of them may be burnt by peculiar contrivances.

The following are the principal metals now known.

Of Gold.

Gold is always found in nature in a metallic state. It is generally met with in grains, called gold-dust, mixed with the sand of rivers; being carried away by them from the rocks and mountains, where it is found in leaves or ramifications, adhering to quartz, and other stones.

It is of a rich yellow colour; and is the heaviest of metals, except plantina. It is not very hard when pure. It is the most ductile of all the metals. It cannot be oxidated by any heat of a furnace, but may by electricity and galvanism.

Gold is not acted upon by any acid, except the oxygenated muriatic, or nitro-muriatic acids, which latter was called from this aqua regia, because gold was named by the alchymists the king of the metals. With silver it forms an alloy of considerable ductility. Copper heightens its colour, and renders it harder

Tin and lead considerably impair its tenacity. With platina it forms an alloy which is very ductile. With zinc it affords a brittle and hard mixture, susceptible of polish. It unites well with iron, and hardens it remarkably.

On account of its peculiar property of not tarnishing in the air, it is much used for defending other metals; and on account of its beautiful lustre, it is much employed in ornaments. Its specific gravity is 19.3.

Of Platina.

Pure or refined platina is by much the heaviest body in nature. Its sp. gr. is 21.5. It is very malleable, though considerably harder than either gold or silver; and it hardens much under the hammer. Its colour on the touchstone is not distinguishable from that of silver. Pure platina requires a very strong heat to melt it; but when urged by a white heat, its parts will adhere together by hammering. This property, which is distinguished by the name of welding, is peculiar to platina and iron, which resemble each other likewise in their infusibility.

Platina is not altered by exposure to air; neither is it acted upon by the most concentrated simple acids, even when boiling, or distilled from it. Its ore has recently been found to contain, likewise, four new metals, palladium, iridium, osmium, and rhodium; which see; beside iron and chrome.

Of Silver.

Silver is the whitest of all metals, considerably harder than gold, very ductile and malleable, but less malleable than gold; for the continuity of its parts begins to break when it is hammered out into leaves of about the hundred and sixty thousandth of an inch thick, which is more than one-third thicker than gold leaf; in this state it does not transmit the light. Its specific gravity is from 10.4 to 10.5. It ignites before melting, and requires a strong heat to fuse it. The heat of common furnaces is insufficient to oxidize it; but the heat of the most powerful burning lenses vitrifies a portion of it, and causes it to emit fumes; which, when received on a plate of gold, are found to be silver in the metallic state. It has likewise been partly oxidized by twenty successive exposures to the heat of the porcelain furnace at Sevres. By passing a strong electric shock through a silver wire, it may be converted into a black oxide; and by a powerful galvanic battery, silver leaf may be made to burn with a beautiful green light. Lavoisier oxidized it by the blowpipe and oxygen gas; and a fine silver wire burns in the kindled united stream of oxygen and hydrogen gases. The air alters it very little, though it is disposed to obtain a thin purple or black coating from the sulphurous vapours, which are emitted from animal substances, drains, or putrefying matters. This coating, after a long series of years, has been observed to scale off from images of silver exposed in churches; and was found, on examination, to consist of silver united with sulphur.

Of Mercury.

Mercury, called also quicksilver, always appears in a liquid state, in the common temperature of the atmosphere; but in intense cold, as at 40 below zero, it becomes solid, and is then malleable, resembling silver. It is found in nature, sometimes in a pure state, but chiefly united to sulphur, when it forms cinnabar; and sometimes to silver. It is also united to the acids, and to oxygen. It is mostly found in Spain and South America. Like other fluids, it boils, and is converted into vapour. This process is employed to separate it from other substances. It is acted upon by most of the acids. It combines with sulphur and phosphorus; and forms alloys with most of the metals, which are then called amalgams. On this property depend some of the methods of gilding and of silvering mirrors. When acted upon by heat and air for a long time, it absorbs oxygen, and is converted into a real oxide, called precipitate per se, or red oxide of mercury. When the heat is increased, this oxide gives out its oxygen, the mercury reassuming its metallic appearance. When agitated long in air, mercury is converted into a black oxide.

Of Palladium.

This is a new metal, first found by Dr. Wollaston associated with platina, among the grains of which he supposes its ore to exist, or an alloy of it with iridium and osmium, scarcely distinguishable from the crude platina, though it is harder and heavier.

If crude platina be dissolved in nitro-muriatic acid, and precipitated with a solution of muriate of ammonia in hot water; the precipitate washed, and the water added to the remaining solution, and a piece of clean zinc be immersed in this liquid, till no farther action on it takes place; the precipitate now thrown down will be a black powder, commonly consisting of platina, palladium, iridium, rhodium, copper, and lead. The lead and copper may be separated by dilute nitric acid. The remainder being then digested in nitro-muriatic acid, and common salt about half the weight of the precipitate added on the solution, on evaporating this to dryness by a gentle heat, the result will be triple salts of muriate of soda with platina, palladium, and rhodium. Alcohol will dissolve the first and second of these; and the small portion of platina may be precipitated by sal ammoniac. The solution being diluted, and prussiate of potash added, a precipitate will be thrown down, at first of a deep orange, and afterward changing green. This being dried, and heated with a little sulphur before the blow-pipe, fuses into a globule, from which the sulphur may be expelled by exposing it to the extremity of the flame, and the palladium will remain spongy and malleable.

It may likewise be obtained by dissolving an ounce of nitrate of potash in five of muriatic acid, and in this mixture digesting the compound precipitate mentioned above. Or more simply by adding to a solution of crude platina, a solution of prussiate of mercury, on which a flocculent precipitate will gradually be formed, of a yellowish-white colour. This is prussiate of palladium, from which the acid may be expelled by heat.

Palladium is of a greyish-white colour, scarcely distinguishable from platina, and takes a good polish. It is ductile and very malleable; and being reduced into thin slips is flexible, but not very elastic. Its fracture is fibrous, and in diverging striæ, showing a kind of crystalline arrangement. In hardness it is superior to wrought iron. Its specific gravity is from 10.9 to 11.8.

Of Rhodium.

Rhodium exists in crude platina, and was discovered by Dr. Wollaston. It is of a white colour; no degree of heat that has yet been applied to it is capable of melting it, of course many of its properties remain unknown. When united with sulphur it is readily melted; and it forms an alloy with most of the metals except mercury.

Of Iridium.

This substance was discovered by Mr. Tennant in 1803. When crude platina is dissolved in nitro-muriatic acid, a black powder remains, which preceding chemists supposed to be plumbago, but which Mr. Tennant ascertained to be a compound of two new metals. This metal is in appearance like platina, and appears to be as difficult of fusion as that metal, and even more so. It resists the action of the acids; it forms alloys with all the metals tried except arsenic.

Of Osmium.

Osmium was also discovered by Mr. Tennant at the same time with the preceding. It exists in the black powder precipitated during the solution of crude platina. Its name is derived from its peculiar smell. It is of a dark grey or blue colour; resists the action of all the acids: is easily oxidized by heat in the open air; and may be amalgamated with mercury.

Of Copper.

Copper is a metal of a peculiar reddish colour; hard, sonorous, very malleable and ductile, and of great tenacity: specific gravity from 8.6 to 8.9. Besides its employment to make vessels of capacity, and to sheathe the bottom of ships, it is alloyed with zinc to make brass; it is combined with sulphuric acid to form Roman vitriol; and its oxides are employed in enamel painting, and in the manufacture of several colours.

Of Iron.

No metal is so widely diffused through nature as iron, most mineral bodies or stones being found with an admixture of it. Sands, clays, the waters of rivers and springs, are scarcely ever perfectly free from it. The parts of animal and vegetable substances also afford iron in the residues they leave after incineration. In its native state iron is very scarce; most iron being found in the state of oxide, in ochres, and bog-ores, and other earthy substances. The magnet or load-stone is an ore of iron.

Iron is of a bluish white colour, of considerable hardness, and elasticity; very malleable, and exceedingly tenacious. From the intense heat requisite to fuse it, it can only be brought into the shape required by hammering. In a white heat it appears as if covered with a kind of varnish; and in this state two pieces of it when applied together will adhere and may be perfectly united by forging, this process is termed welding, and can be applied to no other metal except platina. Iron is easily oxidized. An iron wire, ignited at one end by a brimstone match attached to it, and plunged into a glass jar of oxygen gas, will be entirely consumed by the successive combustion of its

Highly concentrated sulphuric acid has little effect on iron; but if the acid be diluted with about three parts of water, a violent action takes place, the iron is dissolved, and during the solution large quantities of hydrogen gas escape.

The substances known by the names of steel, and cast-iron, are combinations of iron with different degrees of carbon.

Iron is one of the principal ingredients in dyeing black, and in the manufacture of writing ink. Leather prepared by tanning with oak bark, is blackened by a solution of sulphate of iron.

Of Nickel.

Nickel is a metal of great hardness, of a uniform texture, and of a colour between silver and tin; very difficult to be purified, and magnetical. It even acquires polarity by the touch. It is malleable, both cold and red-hot; and is scarcely more fusible than manganese. Its oxides, when pure, are reducible by a sufficient heat without combustible matter; and it is little more tarnished by heating in contact with air, than platina, gold, and silver. Its specific gravity, when cast, is 8.279; when forged, 8.666.

Nickel is commonly obtained from its sulphuret, the kufernickel of the Germans, in which it is generally mixed also with arsenic, iron, and cobalt. The alloys which it forms are but imperfectly known: they are brittle and hard, and have never been applied to any useful purpose.

Of Tin.

Tin is of a fine white colour, with a shade of blue: it has a slightly disagreeable taste, and when rubbed emits a peculiar smell. Its specific gravity when hammered is 7.299. It quickly tarnishes when exposed to the air; but is not altered when kept under water. It is the brightest of metals, and very ductile, but at the same time tenacious and flexible. It enters into combination with most other metals, and its alloys are highly useful in the manufacture of hardware goods.

Of Lead.

Lead is of a bluish white colour, and when newly melted is very bright, but soon tarnishes when exposed to the air. It is the softest of all the metals; it does not become harder by hammering; it may be reduced to very thin plates, but its tenacity and ductility are not considerable. The use of lead is very extensive. Of the oxides of lead there are; 1. the powder precipitated by potash from the nitrate of lead; this is termed the yellow protoxide, which, when somewhat vitrified, constitutes litharge, and, when combined with carbonic acid, white lead, or ceruse. 2. When massicot has been exposed for about 48 hours to the flame of a reverberatory furnace it becomes red-lead, or minium. 3. If upon 100 parts of red-led we digest nitric acid of the specific gravity 1.26, part of it will be dissolved, the remaining part is peroxide of lead. The specific gravity of lead is 11.407.

Of Zinc.

Zinc is of a brilliant white colour, with a shade of blue, and is composed of thin plates cohering together. It is somewhat harder than silver. Its specific gravity when hammered is 7 1908. Zinc was formerly supposed not to be ductile: but if heated to a little above 212°, it becomes very malleable, and may be drawn into wires. Combined with copper, zinc forms one of the most useful alloys, namely brass.

The sulphuric acid diluted with water dis-

solves zinc very rapidly; in this process the water is decomposed, and much hydrogen escapes. By evaporating the liquor, sulphate of zinc, or white vitriol may be obtained in crystals.

Of Bismuth.

Bismuth is of a reddish white colour, and is usually found in silver and tin mines. It is composed of broad brilliant plates adhering to each other, and is harder than silver. Its specific gravity is 9.882. *Bismuth is not malleable; it is used chiefly in the composition of pewter, solder, printing types, &c.*

Of Antimony.

See ANTIMONY.

Of Tellurium.

This metal is of a bluish white colour, its texture laminated, and its brilliancy considerable. It is very brittle; its specific gravity 6.115. It melts a little above the melting point of lead. When exposed to the action of the blow-pipe, it burns with a bluish flame, and is converted into a white oxide. It may be combined with sulphur by fusion, and amalgamated with mercury. The metallic alloys which it is capable of forming are not known.

Of Arsenic.

Arsenic is often found native. When combined with sulphur it is called orpiment. It is also often united with metals. See ARSENIC.

Of Cobalt.

Cobalt is a brittle, somewhat soft, but difficultly fusible metal, of a reddish-grey colour, of little lustre, and a specific gravity of 8.6. Its melting point is said to be 130° Wedgewood. It is generally associated in its ores with nickel, arsenic, iron, and copper; and the cobalt of commerce usually contains a proportion of these metals.

Cobalt is susceptible of magnetism, but in a lower degree than steel and nickel.

Of Manganese.

Manganese is a metal of a dull whitish colour when broken, but which soon grows dark by oxidation, from the action of the air. It is hard, brittle, though not pulverizable, and rough in its fracture; so difficultly fusible, that no heat yet exhibited has caused it to run into masses of any considerable magnitude. Its specific gravity is 8.0. When broken in pieces, it falls into a powder by spontaneous oxidation.

The black oxide of manganese is found very generally. It is procured in the greatest purity in the neighbourhood of Exeter, and is very much used for obtaining the oxygenated muriatic acid gas employed in bleaching. It is also used by glass-makers for destroying the green or yellow tint of glass; and for this reason has been called glass-maker's soap. It is also employed for giving a violet colour to glass and porcelain. In a metallic state it is of a grey colour, not at all malleable, and more infusible than iron.

Where oxygen gas is wanted for philosophical experiments, the black oxide of manganese will be found to furnish it, at a cheap rate, in greater abundance than any other substance known to yield it.

Of Chromium.

This metal was first discovered by Vauquelin, who extracted it from the red lead ore of Siberia. Its colour is white, specific gravity 5.90. It is brittle; takes a good polish, and is magnetic, but less so than nickel and cobalt. Both heat and the acids act upon it with difficulty; on this account it has hitherto been met with only in small grains.

Of Uranium.

This metal is but little known; and it appears doubtful if it has ever been obtained in a state of purity, since the different specimens of different chemists have all differed in specific gravity. It has been found in France; *and some specimens of great beauty have been found in Cornwall. It is of a grey colour;* brittle, and extremely difficult of fusion.

Of Molybdenum.

Molybdenum is a metal which has not yet been reduced into masses of any magnitude; but has been obtained only in small separate globules, in a blackish brilliant mass. This may be effected by making its acid into a paste with oil, bedding it in charcoal in a crucible, and exposing it to an intense heat.

Of Tungsten.

Tungsten is obtained by exposing a mixture of tungstic acid and charcoal to a strong heat. The name given to this metal signifies heavy stone. It is of an iron colour, very hard, and brittle, and difficult of fusion. According to Professor Brande, its specific gravity is 17.5. By the action of heat and air it is converted into an oxide, which is of a yellow colour.

Of Columbium.

This metal, as its name imports, was discovered in a mineral from North America, by Mr. Hatchett. Berzelius appears to be the only person who has succeeded in obtaining Columbium. He describes it as having the colour of iron; as being very hard, and brittle; and burning at a red heat into a whitish oxide.

Of Titanium.

This name was given to a metallic substance discovered by Mr. Gregor in a kind of ferruginous sand found in Cornwall. It is so refractory that most persons have failed in their attempts to reduce it. Lampadius is said to have succeeded. Its colour is that of copper; with a metallic brilliancy; is very brittle, but in small scales it is very elastic.

Of Cerium.

Cerium was obtained by Hisinger and Berzelius from a mineral found in Sweden, to which they gave the name of *Cerite.* This metal is extremely difficult of fusion: Mr. Children, however, succeeded in fusing it by the aid of his powerful voltaic apparatus. It burned with a vivid flame, and was partly volatilized. It is a hard, white, brittle metal.

Of Potassium.

This metal was discovered by Sir H. Davy in 1807. He obtained it by submitting caustic potash to the action of voltaic electricity; the metal was slowly evolved at the negative pole. Potassium is a white metal of great lustre; it is ductile, and of the consistency of soft wax. It is lighter than water, its specific gravity being 0.85. When exposed to the air it instantly tarnishes, and must be kept in pure naphtha. It is a conductor of electricity. When thrown upon water, it acts with great violence, and swims on the surface, burning with a beautiful light of a red colour. The water becomes a solution of pure potash

On all fluid bodies which contain water, or much oxygen or chlorine, it readily acts; and

in its general powers of chemical combination, says its illustrious discoverer, potassium may be compared to the alkahest, or universal solvent, imagined by the alchemists.

Of Sodium.

This metallic substance appears to be the basis of soda, and was discovered by Sir H. Davy a few days after he discovered potassium. It is procured in the same way as potassium, which it resembles in many of its properties. It operates on most substances in a similar manner, but with less energy; and to keep it from tarnishing it must be preserved in naphtha.

Of Barium.

According to Sir H. Davy, barium is of a grey colour, about twice the weight of water. It greedily absorbs oxygen, and burns with a deep red light when gently heated, producing the oxide of barium. It is the metallic basis of the earth called barytes; and is produced by the application of the voltaic apparatus. See Barium.

OF LIGHT.

The physical properties of light will be considered under Optics. This substance seems to have considerable influence upon many chemical processes. The effect of light upon vegetation is well known. Many flowers follow the course of the sun; and plants that grow in houses, seem solicitous to turn to the light. Plants that grow in the shade, or in darkness, are pale, and without colour: and when this is the case, they are said to be etiolated or blanched. Gardeners avail themselves of this fact to render vegetables white and tender. The more plants are exposed to the light, the more colour they acquire. Yet the dead vegetable is deprived of colour by exposure to it.

Vegetables are not only indebted to light for their colour, their taste and odour are derived from the same source. From this cause it happens that hot climates are the native countries of perfumes, odoriferous fruits, and aromatic resins. The action of light on the organs of vegetables causes them to pour out streams of pure air from the surfaces of their leaves, while exposed to the sun: whereas, on the contrary, when in the shade, they emit air of a noxious quality. Even animals, in general, droop when deprived of light; and it appears to be of great importance to the health and happiness of human beings.

OF CALORIC.

The general opinion on the nature of caloric seems now to be that it is a peculiar substance, and not, as was formerly supposed, a mere property of matter. This opinion has been much strengthened by the discovery of Dr. Herschell, who found, while examining the sun by means of telescopes, that the most refrangible rays have the least heating power; and that the heating power gradually increases as the refrangibility diminishes. From these experiments it was concluded that the rays of caloric, proceeding from the sun, are not the same with the rays of light. See Caloric.

OF EARTHS.

Those substances known by the name of earths are nine in number and are by chemists divided into *Alkaline* earths, and earths proper. The leading properties of earths are the following.

1. Insolubility in water, or at least becoming so when combined with carbonic acid.
2. Little or no taste or smell, at least when combined with carbonic acid.
3. Fixed, incombustible, and incapable, when pure, of being altered by fire.
4. A specific gravity not exceeding 4.9.
5. When pure, capable of assuming the form of a white powder.
6. Not altered when heated with combustibles.

Of the Alkaline Earths.

1. *Lime.*—Lime is seldom found in a pure state; it is contained in chalk, which may be deemed a neutral salt, being formed by the combination of lime with carbonic acid. The best process for obtaining lime in a state of purity is this: wash chalk in distilled water, brought to a state of ebullition, and then dissolve it in distilled acetous acid: this acid, by combining with the lime, expels the carbonic acid, which escapes under the gaseous form; then precipitate the lime by carbonate of ammonia, for the acetous acid abandons the lime, in order to combine with the ammonia, and the lime is precipitated: wash and calcine this precipitate, and the residuum will be pure lime.

Lime is soluble in water, but in very small quantities; more than 600 parts of water are necessary to dissolve one of it. It has a pungent, hot, and acrid taste; it turns blue vegetable colours green. It takes up water with avidity. When thrown into this liquid it splits, swells up, acquires a larger volume, and a great heat. It dissolves in acids without effervescence. The borate of soda and the phosphates of urine dissolve it also.

Lime, when alone, is infusible, even though the fire may be urged by oxygen gas, as has been proved by Lavoisier; but if combined with acids, it forms a fusible body, for lime is a salifiable base. Of all these bases it is that most abundantly diffused throughout nature.

2. *Magnesia.*—Magnesia has never yet been found free from every kind of foreign matter. To procure it in the utmost degree of purity, crystals of the sulphate of magnesia (Epsom salt,) of which it forms the base, must be dissolved in distilled water, and decomposed by alkaline carbonates: the sulphuric acid combines with the alkalis; the magnesia with the carbonic acid, and is precipitated. This precipitate must then be calcined, in order to disengage the carbonic acid; and what remains will be pure magnesia.

Pure magnesia is exceedingly white, tender, and in appearance spongy. When perfectly pure, it is not sensibly soluble in water. It excites no sensible savour on the tongue; and in this respect it is greatly different from lime.

3. *Barytes.*—Barytes, or ponderous earth, has never yet been found pure and free from all combination It is found under the pulverulent form, and exceedingly white. It gives a very slight tint of green to blue vegetable colours. Its specific gravity is from 4.2 to 4.3. Analysis has proved that 100 parts of carbonate of barytes contain 62 of barytes, 22 parts of carbonic acid, and 16 parts of water.

4. *Strontian.*—This earth was discovered by Dr. Hope, professor of Chemistry at Edinburgh. It is found in the state of a carbonate, that is, combined with carbonic acid, in a vein of lead ore, at Strontian in Argyleshire, in the western part of Scotland. It has been found also combined with carbonic acid at Lead-hills, in the same country. Some of it has since been discovered at Montmartre in France, combined with sulphuric acid; and it is found in quantities in the neighbourhood of Bristol.

Strontian was at first confounded with barytes which indeed it resembles in several respects, though it differs from it in others.

Carbonate of strontian is decomposed by the sulphuric acid, and carbonic acid is disengaged: the sulphate of strontian, thus obtained, is very little soluble in water. It dissolves with effervescence in the nitric and muriatic acids, and carbonic acid is disengaged. These nitrates and muriates of strontian are not deliquescent, and are decomposed by the sulphates of lime, potash, and others. It may be deprived of its acid by calcination; its earth is then soluble in water, but in greater quantity in boiling than in cold water, for a part of it is precipitated by cooling.

The carbonate of strontian is lighter than carbonate of barytes; the specific gravity of the latter is from 4.2, to 4.3, that of the carbonate of strontian is only from 3.6, to 3.7. Analysis has proved, that 100 parts of the carbonate of strontian contain 62 parts of strontian, 30 parts of carbonic acid, and 8 parts of water.

Of the Earths Proper.

1. *Alumina.*—Alumina, or pure argil, is found chiefly in the different kinds of clay, of which it forms the base, and where it is often mixed with silex. To obtain it very pure, sulphate of alumina (alum) must be dissolved in water, and afterwards decomposed by alkaline carbonates. The alkali combines with the sulphuric acid, which then abandons the alumina; and the latter combines with the carbonic acid abandoned by the alkali. The alumina must then be freed from this acid by calcination; and after this process it will remain pure. It absorbs water with avidity, and becomes diluted in that liquid. It adheres strongly to the tongue. The borate of soda and the phosphates of urine dissolve it. When exposed to heat, it becomes dry, shrinks, and cracks. By the action of the fire it acquires so great hardness as to strike fire with steel: it is then no longer susceptible of being diluted in water. Alumina, even when perfectly pure, is completely fusible in the fire, if urged by a current of oxygen gas. The result of its fusion is a vitreous, opaque, and very hard substance, which scratches glass in the same manner as precious stones do.

2. *Yttria.*—This earth was discovered by Gadoline in a Swedish mineral, of a black colour, to which the name of Gadolonite has been given. When prepared, it is a fine white powder without taste or smell; it is insoluble in water, and heat does not melt it. It is also insoluble in pure alkalis, but readily soluble in alkalis when carbonated. Sp. gr. 4.842.

3. *Glucina.*—Glucina is a simple earth, lately discovered by Vauquelin, in the aigue-marine, called the occidental. It is a white granular earth, which effervesces with acids. In 100 parts of the aigue-marine there are 14 of glucina. It is soluble in the carbonate of ammonia, as well as in the sulphuric acid. In the latter case, the solution has at first a saccharine, and afterwards an astringent taste. Its crystals are sweet, like the solution. It has some resemblance to alumina; as it is soft to the touch, adheres to the tongue, is light, dissolves in potash, and is precipitated from its solution by ammonia. But it differs from alumina by its combinations with acids, being exceedingly sweet, by giving no alum when mixed with sulphate of potash, by being entirely soluble in carbonate of ammonia, and by not being precipitated from its solutions by oxalate of potash and tartrite of potash, as alumina is.

It has been found by analysis, that 100 parts of earth contain 68 of silex, 15 of alumina, 14 of glucina, 2 of lime, and of the oxide of iron.

4. *Zirconia.*—Zirconia is a simple earth, lately discovered by Klaproth, in the jargon of Ceylon, of which it is a constituent part, and even the most abundant; for it has been found by analysis, that 100 parts of the jargon of Ceylon contain 64 parts and a half of zirconia, 32 parts of silex, and two parts and a half of the oxide of iron. To obtain zirconia pure, it must be united to the muriatic acid, with which it forms a muriate of zirconia: this muriate must be dissolved on a large quantity of water, and the zirconia must be precipitated by potash: if it is carefully washed, and then brought to a red heat in a crucible, it will be perfectly pure. Calcined zirconia has a white colour. It is rough to the touch like silex; it has no taste, and is not soluble in water. Its specific gravity is at least 4.3; that of distilled water being 1.0.

When separated from its solutions by caustic alkalis, this earth retains a pretty large quantity of water, which gives it the semi-transparency of horn; it has then the appearance of gum-arabic, both by its slightly yellow colour and its fracture and transparency. It is susceptible of uniting with carbonic acid. It unites also with the sulphuric and nitrous acids: alkalis, and the first six primitive earths, separate it from the latter acid. It will not alone fuse by the blowpipe; but it fuses with the borate of soda, and gives a transparent colourless glass.

5. *Silex, or Silica.*—Silex, or vitrifiable earth, is almost in its state of purity in rock-crystal: but to have it perfectly pure, one part of beautiful rock-crystal must be fused with four parts of pure alkali; the mixture must then be dissolved in water, and precipitated by an excess of acid: the precipitate will be pure silex, which is rough and harsh to the touch; its particles, when diluted in water, are easily precipitated.

The fluoric acid dissolves silex exceedingly well: it is also the solvent of glass. Alkalis dissolve silex in the dry way, and with it form glass. Silex cannot be fused by a burning lens; but by exposing it to a fire, urged by oxygen gas, Lavoisier produced a commencement of fusion on its surface.

OF COMPOUND SUBSTANCES.

1. *Water.*—It is scarcely necessary to give any definition or description of this universally

known fluid. It is a [illegible] fluid, possessing a moderate degree of activity with regard to organized substances, which renders it friendly to animal and vegetable life, for both which it is indeed indispensably necessary. Hence [illegible] acts but slightly on the organs of sense, and is therefore said to have neither taste nor smell. It appears to possess considerable elasticity, and yields in a perceptible degree to the pressure of air in the condensing machine, as Canton proved, by including it in an open glass vessel with a narrow neck.

The solubility or insolubility of bodies in this fluid composes a large part of the science of chemistry. See Salt.

Native water is seldom, if ever, found perfectly pure. The waters that flow within or upon the surface of the earth, contain various earthy, saline, metallic, vegetable, or animal particles, according to the substances over or through which they pass. Rain and snow waters are much purer than these, although they also contain whatever floats in the air, or has been exhaled along with the watery vapours.

The composition of water is best demonstrated by exploding 2 volumes of hydrogen and 1 of oxygen, in the eudiometer. They disappear totally, and pure water results.

II. *Alcohol.*—See Alcohol.

III. *Oils.*—The distinctive characters of oil are inflammability, insolubility in water, and fluidity, at least in a moderate temperature. Oils are distinguished into fixed or fat oils, which do not rise in distillation at the temperature of boiling water; and volatile or essential oils, which do rise at that temperature with water, or under 320° by themselves.

The volatile oil obtained by attenuating animal oil, by a number of successive distillations, is called Dippel's animal oil.

Monnet asserts, that, by mixing acids with animal oil, their rectification may be very much facilitated.

The addition of a little ether, before re-distillation of old essential oils, improves the flavour of the product.

IV. *Alkalis.*—The term alkali is now applied to all substances having the following properties.

1. A caustic taste. 2. Volatilized by heat. 3. Capable of combining with acids, and of destroying their acidity. 4. Soluble in water, even when combined with carbonic acid. 5. Capable of converting vegetable blues to green.

The alkalis at present known are these.

1. Ammonia; 2. Potash; 3. Soda. The first is called *volatile alkali*; the two last are called *fixed alkalis*. The alkalis will be found more fully described under their respective names.

V. *Acids.*—The name of *acid* is given to all substances, whether liquids or solids, which produce that sensation on the tongue, which we call *sour*; which change the blue juices of vegetables to *red*, and combine with alkalis, earths, or metallic oxides, so as to form those compounds called *salts*. When two acids have the same radical, but contain different quantities of oxygen, each acid is distinguished by its termination. The name of that which contains most oxygen ends in *ic*, the other in *ous*. Thus we say *sulphuric* acid, and *sulphurous* acid; *phosphoric* acid, and *phosphorous* acid. To express the presence of a greater quantity of oxygen, the word *oxygenized* is added to the name of the acid, as oxymuriatic acid (now chlorine).

2. The acids have been divided by Dr. Thomson into acid products, acid supporters, combustible acids, and colorific acids. i. Acid Products consist of *sulphuric* acid, formerly called oil of vitriol, and vitriolic acid; *sulphurous* acid; *phosphoric, phosphorous* acids; *carbonic* acid, formerly called fixed air; *boracic* acid, from the salt called borax; and *fluoric* acid, from the *fluor* spar, or Derbyshire spar. ii. Acid Supporters contain *nitric* acid, called aqua fortis and spirit of nitre; *nitrous* acid; *oxymuriatic* acid, or chlorine; and the *arsenic, tungstic, molybdic, chromic,* and *columbic* acids, obtained from the metals arsenic, tungsten, molybdenum, chronium, and columbium. iii. Combustible Acids, are *acetic* acid, from wine or beer; *benzoic*, from the resin called benzoin; *sebacic*, from fat; *succinic*, from amber; *moroxylic*, from a saline exudation on the bark of the white mulberry tree; *camphoric*, from camphor: *oxalic*, from the wood-sorrel; *mellitic*, from the mellite of honey-stone; *tartaric*, from tartar; *citric*, from oranges and lemons: *kinic*, from a salt in the jesuit's bark: *saclactic*, from sugar of milk; *uric*, in human calculi; *malic*, from apples; *suberic*, from cork; and the *formic*, from the red ant. iv. Colorific Acids, or those which cause colour, are the *prussic*, which is the colouring matter of prussian blue, and the *gallic* acid obtained from nut-galls, a concretion formed on the oak in consequence of the puncture of insects. The acids are indispensable in various arts and manufactures; are employed for culinary purposes, and in medicine: and act an important part in the great laboratory of nature.

The preceding may be denominated compounds of the *first order*: and hence those substances which consist of combinations of these are termed compounds of the *second order*, or *doubly compound* substances. These may be reduced to three classes. 1. Soaps. 2. Neutral salts. 3. Hydrosulphurets.

1. *Soaps.* The fixed oils have the property of combining with alkalis, earths, and metallic oxides, and the compounds thus formed have received the name of Soaps. These soaps differ from each other very materially, according as their base is an alkali, an earth, or a metallic oxide.

2. *Neutral salts.* The term *salt* was originally confined to common salt; it was afterwards generalized by chemists, and applied to all bodies which are sapid, easily melted, soluble in water, and not combustible. It was then confined to acids, alkalis, and the compounds formed by the union of these bodies with each other; but it is now applied to all the compounds which the acids form with alkalis, earths, and metallic oxides. Every species of salt is distinguished by subjoining to the generic term the name of its base. Thus the salt composed of sulphuric acid and soda, is called *sulphate of soda*. Triple salts are distinguished by subjoining the names of both the bases. Thus the salt composed of tartaric

acid, potash, and soda, is called tartrate of potash and soda.

3. *Hydrosulphurets.* Sulphuretted hydrogen gas possesses many of the properties of an acid, and, like acids, it combines with the salifiable bases, and forms a class of bodies called *hydrosulphurets.* These are of considerable importance, being frequently employed in chemical analysis, to separate the metallic oxides from alkalis and earths. They precipitate almost all the metals from their solutions.

OF CHEMICAL AFFINITY.

Chemical affinity is the attraction which exists between the particles of bodies, which urges them towards each other, and keeps them united. The characteristic marks of affinity may be reduced to the three following.

1. It acts only at insensible distances, and affects only the particles of bodies. 2. Its force is always the same in the same particles, but it is different in different particles. 3. This difference is not affected by the mass.

See Attraction.

CHEMICAL OPERATIONS AND INSTRUMENTS.

The reduction of solids into powders of different degrees of fineness, by *pulverization,* &c. is necessary previously to their being chemically acted upon. But these processes can never reduce substances into their primary or elementary particles: they do not even destroy the aggregation of bodies. The real chemical operations, on the contrary, separate their constituent particles from each other. Brittle substances are reduced to powder by means of hammers, pestles, and mortars, stones, and mullers. Wedgewood's ware affords a most excellent kind of mortar for most purposes, as it is very strong, and not liable to be acted upon by acids. Many bodies cannot be reduced to powder by the foregoing methods: such are fibrous substances, as wood, horns of animals, elastic gum, and metals which flatten under the hammer; for these, files, rasps, knives, and graters, are necessary.

The separation of the finer parts of bodies from the coarser, is performed by means of sifting or washing.

Washing is used for procuring powders of an uniform fineness. The powdered substance is mixed with water, or some other convenient fluid: the liquor is allowed to settle, and is then decanted off; the coarsest powder remains at the bottom of the vessel, and the finer passes over with the liquor. By repeated decantations in this manner, various sediments are obtained, of different degrees of fineness: the last, being the finest.

Filtration is a finer species of sifting. It is sifting through the pores of paper, or flannel, or fine linen, or sand, or pounded glass, or porous stones, and the like; but is used only for separating fluids from solids, or gross particles that may happen to be suspended in them, and not chemically combined with the fluids. Unsized paper is a very convenient substance for making filters for chemical purposes. It is wrapped up in a conical form, and put into a glass funnel, which serves to strengthen the paper and support the weight of the fluid when poured into it.

D[illegible] substituted instead of filtration, for [illegible]rating solid particles which are diffused thro[illegible] liquors. If the sediment is extremely light, and apt to mix again with the fluid, a syphon is used for drawing off the clear fluid.

Lixiviation is the separation by means of water, or other fluid, of such substances as are soluble in it, from those which are not. Thus, if a mineral consists of salt and sand, or salt and clay, &c. the given body being broken to powder, is placed in water, which will dissolve the salt, and keep it suspended, whilst the earthy matter falls to the bottom of the vessel, and, by means of filtration, may be separated from the fluid.

Evaporation separates a fluid from a solid, or a more volatile fluid from another which is less volatile.

Simple evaporation is used when the more volatile or fluid substance is not to be preserved. Various degrees of heat are employed for this purpose, according to the nature of the substances. It is performed in vessels of wood, glass, metal, porcelain, &c. Basons made of Wedgewood's ware are very convenient, as they are not apt to break by sudden changes of heat.

When the fluid which is evaporated must be preserved, then the operation is called *distillation,* which see.

Crystallization.—When a salt is dissolved in water, or other fluid, and by evaporation the fluid is driven off, the salt gradually acquires the solid form, and in doing this, it arranges its particles in different figures. Vessels of earthenware, or glass, are employed for such crystallizations.

Solution.—When a salt is mixed with water, it loses its state of solidity: the particles of salt are divided and unite themselves to those of the water. The same takes place when resin is mixed with spirits of wine. In this process neither the salt nor the water is decomposed; and the salt may be recovered again in its original state and quantity, by evaporation.

The dissolution of metals by acids, however, is of a different nature; here, either the metal, the acid, or the water, is altered, and different products are obtained. Vessels of glass are generally used for solutions and dissolutions. The liquid used for dissolving a metal, or other solid substance, is usually called a solvent, or menstruum.

Precipitation.—The recovery or separation of a body from its solvent, by the addition of a third substance, so that the former may reappear in a solid state, however divided, is called precipitation. The substance thus recovered, is called a precipitate, and the superadded body that occasions this precipitation is called a precipitant.

Fusion.—The melting of any body from the solid to the liquid state, by the action of fire, is called fusion. The fusion of metallic substances requires vessels sufficiently strong to resist the fire. These are mostly, if not always, made of earthen-ware, or porcelain, or a mixture of clay and powder of black-lead, and are called crucibles. Sometimes they have covers, but others are broad and shallow, that the fused metal may be exposed to a current of air. These are named cupels: and are placed

under a sort of oven, made of earthenware, called a muffle; which with the included cupel is exposed to the heat of the furnace.

Furnaces.—In the application of the action of hea[illegible] bodies, furnaces of different forms are employed, according to the operations for which they are intended. A furnace is a kind of hollow cylindric tower; sometimes a little wider at the top, with notches, to give a passage to the air. This furnace ought to have at least two lateral apertures; an upper one which is the door of the fire-hole, and a lower one which is the door of the ash-hole. In the interval between these doors the furnace is divided into two parts by a horizontal grate for supporting the charcoal.

Another kind of furnace often necessary, is that called the reverberating furnace; it consists of an ash-hole, a fire-hole, a laboratory, and a dome. In the laboratory is placed a retort, which is supported by two iron bars that run across the furnace; the neck of it passes through a lateral aperture, and has adapted to it a receiver. As a strong heat is sometimes required for this furnace, a large volume of air must be made to pass through it; and in that case a great deal of heat is disengaged. The use of the dome is to reverberate the heat and flame on the retort, in order that it may every where be exposed to nearly an equal heat.

For farther information on the subject of chemistry, particularly as it respects the latest discoveries, the reader is referred to the article ELECTRO-CHEMISTRY; and for a description of some of the principal articles of chemical apparatus, to the word LABORATORY.

CHENOLEA, a genus of the order monogynia, in the pentandria class of plants. The calyx is globular, one-leafed, five-parted, caps. one-celled, with one smooth seed. There is one species, a native of the Cape.

CHENOPODIUM, GOOSE-FOOT, or WILD ORACH, a genus of the digynia order, in the pentandria class of plants, and in the natural method ranking under the 12th order, holoraceæ. The calyx is pentaphyllous and pentagonal; no corolla; one seed, lenticular, superior. There are 23 species, 13 of which are natives of Britain. Most of them have an aromatic smell. A species which grows near the Mediterranean is used by the Egyptians in sallads, on account of its saltish aromatic taste. From this plant kelp is made in other countries.

CHERLERIA, a genus of the decandria trigynia class of plants. The flower has properly no petals; the nectaria are five in number, roundish and emarginated, very small, and placed in a circular direction. The fruit is a capsule, formed of three valves, and containing three seeds. There is one species.

CHERMES, in zoology, a genus of insects belonging to the order hemiptera. There are 17 species. It is an insect to be met with in great numbers upon the fig-tree. The larva has six feet. The chrysalis differs from it by two flat buds that spring from the thorax, and inclose the wings. These chrysalids are frequently met with on plants.

CHERRY-*tree*, in botany, See PRUNUS.

CHESNUT-*tree*. See FAGUS.

CHESS, an ingenious game, performed with different pieces of wood, on a board divided into 64 squares or houses, in which chance has so small a share, that it may be doubted whether a person ever lost but by his own fault. Each gamester has eight dignified pieces, viz. a king, a queen, two bishops, two knights, and two rooks, also eight pawns; all which, for distinction' sake, are painted of two different colours, as white and black.

CHIEF, in heraldry, is that which takes up all the upper part of the escutcheon, from side to side, and represents a man's head.

CHILIAD, denotes a thousand of any things, ranged in several divisions, each of which contains that number.

CHILIAGON, in geometry, a regular plane figure of 1000 sides and angles.

CHIMARRHIS, a genus of the class and order pentandria monogynia. The essential character is; corolla funnel-formed; capsule inferior, obtuse; two-celled; two-valved; seeds one in each cell. There is one species, a lofty tree, a native of Martinico.

CHIMES *of a clock*, a kind of periodical music, produced at equal intervals of time, by means of a particular apparatus added to a clock.

CHIMNEY, in architecture, a particular part of a house, where the fire is made, having a tube or funnel to carry off the smoke. The effect of chimneys is often destroyed by their being constructed on unscientific principles. It will be found for the most part that the smoking of chimneys arises from their being carried up narrower at the top than at the bottom, and from their being thrown in a zig-zag direction. Now it is evident from the very principle on which smoke rises at all in a chimney, that the higher it rises the less is the force that drives it, and the slower it must move, and consequently the more room it should have to move in, whereas in the usual way it has less. Chimneys, therefore, should be built as nearly perpendicular as possible; they ought to be free from all roughness on the inside; and a few inches wider at the top than at the base. This would effectually prevent smoking; and might be so managed as not to interfere with the form of the exterior.

CHIOCOCCA, a genus of the monogynia order, in the pentandria class of plants, and in the natural method ranking under the 48th order, aggregatæ. The corolla is funnel-shaped and equal; the berry unilocular, dispermous, inferior. There are two species.

CHIONANTHUS, the snow-drop, or fringe-tree, a genus of the monogynia order, belonging to the diandria class of plants, and in the natural method ranking under the 44th order, sepiariæ. The corolla is quadrifid, with the segments very long; the fruit is a plum. There are four species described by botanists. The most remarkable is the chionanthus Virginica, common in Virginia and South Carolina, where it grows by the side of rivulets. It rises to the height of ten feet.

CHIRONIA, a genus of the monogynia order, in the pentandria class of plants, and in the natural method ranking under the 20th order, rotaceæ. There are 10 species, of which the most remarkable is the Chironia frutescens, a native of the Cape of Good Hope.

CHIVALRY, in antiquity, an institution which, according to some writers, took its rise from the crusades; but, according to others, it

gave occasion to that enterprise; and which, though founded in caprice, and productive of extravagance, had a very considerable influence in refining the manners of the European nations during the twelfth, thirteenth, fourteenth, and fifteenth centuries.

CHLORA, a genus of the monogynia order, and octandria class of plants. Calyx octophyllous; corolla, monopetalous and octofid; capsule, unilocular, bivalved, and polyspermous. There are four species.

CHLORANTHUS, in botany, a genus of the class and order tetrandria monogynia. Calyx none; corolla, three lobed; petal by the side of the germ; anthers growing to the petal; drupe seeded. There is one species, a native of China.

CHLORITES, a kind of green jasper almost as pellucid as the coarser emeralds. It is sometimes amorphous, and sometimes chrystalized. There are four species, viz. the earthy chlorite, common chlorite, the foliated and shistose chlorite.

CHOCOLATE, in commerce, a kind of paste, or cake, prepared chiefly from the cacao-nut.

When the cacao is properly roasted, and well cleaned, it is pounded in a mortar, and afterwards ground on a stone, the paste being sufficiently ground, it is put hot into tin moulds, in which it congeals in a very little time. Complaints are made, that the Spaniards mix with the cacao-nuts too great a quantity of cloves and cinnamon, besides other drugs, as musk, ambergris, &c. In England, the chocolate is made of the simple cacao, excepting that sometimes sugar, and sometimes vanilla, is added.

CHOLERA *morbus*. See Medicine.

CHONDRILLA, a genus of the polygamia æqualis order, in the syngenesia class of plants; and in the natural method ranking under the 49th order, compositæ. There are three species.

CHORD, in geometry, a ri[illegible] line drawn from one part of an arch of a circle to the other.

CHORDS, *line of*, one of the lines of the sector and plane scale.

Chords, in music, are strings, by the vibration of which the sensation of sound is excited, and by the divisions of which the several degrees of tune are determined.

CHOROGRAPHY, the art of delineating or describing some particular country or province: it differs from geography as a description of a particular country differs from that of the whole earth; and from topography, as a description of a country differs from that of a town or district.

CHROMATICS. See Optics.

CHRONOLOGY, from Χρονος, *time*, and Λογος, *doctrine*, is that science which treats of the natural and artificial divisions of time, and refers to the points which it thus marks out, the various events recorded in history. Chronology may be divided into, 1. Mathematical chronology, which treats of the division of time into days, months, years, and cycles, and of the application of these divisions to the purposes of civil life.

2. Historical chronology, which treats of the eras and epochs fixed upon by different nations for determining the order of dates and facts in their annals; or it may be said to treat of all those historical documents which are used for establishing the existence of events, and the order in which they happened; such as eclipses, public registers, medals, columns, obelisks pyramids, &c.

3. Comparative chronology, which treats of the comparison of different eras, and is of the greatest importance in facilitating the study of history.

4. Tabular chronology, or that branch of the science in which all the leading events recorded in history are arranged in the order of time in which they happened. Tables of this description should include all the great political events which accompany the rise and fall of empires: the most striking natural phenomena; and an account of all the great men who have acted a conspicuous part, as philosophers, statesmen, and warriors. Chronological tables, with problems, &c., and suitable rules for their solution are to be found in almost every elementary work on astronomy, on which account it is deemed unnecessary to introduce them here.

CHRONOMETER, an instrument or machine for measuring time. The word is more particularly used to denote a portable machine, in which, by the nature of the escapement and the compensations for heat and cold, mean time is, or ought to be, kept with sufficient accuracy to determine the longitude at sea.

CHRYSALIS, in natural history, a state of rest and seeming insensibility which butterflies, moths, and several other kinds of insects, must pass through before they arrive at their winged or most perfect state. The first state of these animals is in the caterpillar or reptile form; then they pass into the chrysalis-state, wherein they remain, immoveably fixed to one spot, and surrounded with a case or covering, which is generally of a conical figure; and, lastly, after spending the usual time in this middle state, they throw off the external case wherein they lay imprisoned, and appear in their most perfect and winged form of butterflies, or

CHRYSIS, or gold-fly, a genus of insects belonging to the hymenoptera order. There are seven species, of which the lucidula is one: it is beautified with the most splendid colours. The fore part of the head is green and gold, and the hinder of a bright azure. The thorax is azure and green: the abdomen is green and gold before, and of a coppery red behind. This species lives in holes of walls.

CHRYSITRIX, in botany, a genus of the diœcia order, in the polygamia class of plants. There is one species, a native of the Cape.

CHRYSOBALANUS, cocoa plum: a genus of the monogynia order, and icosandria class of plants; and in the natural method ranking under the 36th order, pomaceæ. There is only one species, the chrysobalanus icaco, a native of the Bahama Islands and many other parts of America, but commonly grows near the sea. It rises with a shrubby stalk eight or nine feet high.

CHRYSOCOMIA, goldy-locks: a genus of the polygamia æqualis order, in the syngenesia class of plants; and in the natural method ranking under the 49th order, compositæ. There are thirteen species, the most remarkable of which are the linosyris and the cernua.

These are herbaceous flowering perennials, growing from one to two feet high, ornamented with narrow leaves, and compound floscular flowers of a yellow colour.

CHRYSOGONUM, a genus of the polygamia necessaria order, in the syngenesia class of plants; and in the natural method ranking under the 49th order, compositæ. There is one species, a native of Virginia.

CHRYSOLITE. *Peridot* of Haüy. Topaz of the ancients, while our topaz is their chrysolite. Chrysolite is the least hard of all the gems. It is scratched by quartz and the file. Its crystals are well formed compressed prisms, of eight sides at least, terminated by a wedged form or pyramidal summit, truncated at the apex. Its primitive form is a right prism, with a rectangular base. It has a strong double refraction, which is observed in looking across one of the large sides of the summit and the opposite face of the prism. The lateral planes are longitudinally streaked. The colour is pistachio green, and other shades. External lustre splendent. Sp. gr. 3.4. Chrysolite comes from Egypt, where it is found in alluvial strata. It has also been found in Bohemia, and in the Circle of Bunzlau.

CHRYSOMELA, in zoology, a genus of insects of the order of coleoptera, there are 122 different species, denominated from the trees on which they feed, as the chrysomela of tansy, beech, alder, willow, &c.

CHRYSOPHYLLUM, the BULLY TREE: a genus of the monogynia order, in the pentandria class of plants; and in the natural method ranking under the 43d order, viz. dumosæ. The corolla is campanulated, decemfid, with the segments alternately a little patent. The fruit is a ten-seeded berry. There are six species, natives of the West Indies. The most remarkable are:

1. The Chrysophyllum cainito, rises thirty or forty feet high.

2. Chrysophyllum glabrum, never rises to the height of the cainito, nor do the trunks grow to half the size.

CHRYSOPRASE. This mineral, which is found in several parts of Germany, is always amorphous. Its fracture is either even or inclined to the splintery, with very little lustre; its colour green; specific gravity 2.5.

CHRYSOPLENIUM, a genus of the digynia order, in the decandria class of plants; and in the natural method ranking under the 12th order, succulentæ. The calyx is quadrifid or quinquefid, and coloured; no corolla; the capsule birostrated, unilocular, and polyspermous. Its English name is golden saxifrage. There are two species, common in the northern parts of Europe.

CHURN, an implement for agitating cream or milk, so as to effect the production of butter. Some churns are made upright, of a tapering form, and are worked by means of a pole and cross: the former passing through a hole in the lid. These are pail or bell-churns. A great variety of churns are in use; but, in general, their formation evinces more ingenuity than practical knowledge

CHYLE. See ANATOMY.

CICADIA, the FROG-HOPPER, or flea-locust, a genus of insects belonging to the order of hemiptera. The beak is inflected; the antennæ are setaceous: the four wings are membranaceous and deflected; and the feet in most of the species, are of the jumping kind. The species are fifty-one. The larvæ of several of this genus evacuate great quantities of a frothy matter upon the branches and leaves of plants, in the midst of which they reside. It is in the midst of this foamy substance that the larva goes through its metamorphosis into a chrysalis and perfect insect.

CICCA, a genus of the tetrandria order, in the monoecia class of plants. The male calyx is tetraphyllous; there is no corolla; the female calyx triphyllus: no corolla; four styles; the capsule four-berried. There is one species, a shrub of the East Indies.

CICER, the *chick-pea*, a genus of the decandria order, in the diadelphia class of plants, and in the natural method ranking under the 32d order, papilionaceæ. There is but one species, which produces peas shaped like the common ones, but much smaller. They are cultivated in Spain, where they are natives.

CICHORIUM, *succory*, a genus of the polygamia æqualis order, in the syngenesia class of plants; belonging to the 49th natural order, compositæ. There are three species, 1. Cichorium endivia, the common endive, which is both an annual and biennial plant, and used as a sallad. 2. Cichorium intibus, or wild succory, grows naturally by the side of roads and in shady lanes. It is good in scorbutic complaints. 3. Cichorium spinosum, with a prickly stalk, grows in Sicily and the islands of the Archipelago.

CICINDELA, the *sparkler*, in zoology, a genus of coleopterous insects, of which there are 14 species. The campestris or field sparkler is one of the most beautiful. The upper part of the body is of a bluish green colour and rough; the under side, legs, and antennæ, are gold and red. The eyes are prominent. The thorax is angular and narrower than the head. Both are of a green colour tinged with gold. This insect runs, as well as flies, with great swiftness. It is found in dry sandy places, especially in the beginning of spring The larvæ of all this genus live under ground, and are, as well as the perfect insects, very fierce, attacking and destroying all they can.

CICUTA, *water hemlock*, a genus of the order digynia in the pentandria class of plants, ranking in the natural method under the 45th order umbellatæ. There are three species, 1. Cicuta bulbifera; 2. Cicuta maculata; 3. Cicuta virosa. This last is the only one remarkable, and that for the poisonous qualities of its roots.

CIDER, is the name of a fermented liquor, which is made in England, in great quantities, from the expressed juice of apples. The apples should be mellow ripe, and gathered when perfectly dry. It was formerly supposed that "the worse the fruit the better the cider," but this opinion has been refuted. The best pippins make the best flavoured cider, and such as are duly ripe, will produce a proportionate increase both of the quantity and of the flavour.

When the apples are gathered, they are ground in a mill into what is termed pommage. This pulp is then conveyed into the cider-press when it is formed by pressure into a kind

of cake called the cheese. This is effected by laying hair cloths between the layers of pommage, till there is a pile of ten or twelve layers. The whole is then pressed till all the *must* or *juice* is squeezed from it. This juice is then passed through a coarse hair sieve, after which it undergoes the process of fermentation in vats. When the fermentation has ceased, the liquor is put into casks, and kept in a cool place during winter. The proper time for racking it off may be known by the brightness of the liquor; the discharge of the fixed air; and the appearance of a *thick crust* on its surface. About the beginning of March it will be bright and pure, and is then fit for final racking and bottling.

CIMEX, or *bug*, in zoology, a genus of insects belonging to the order of hemiptera. The rostrum is inflected. The antennæ are longer than the thorax. The wings are folded together crosswise, the upper ones are coriaceous from their base towards their middle. The back is flat; the thorax margined. The feet are formed for running. The cimex lectularius, or house bug, is particularly acceptable to the palate of spiders in general, and is even sought after by wood bugs. Trials have been made of various methods of destroying house-bugs, with oil of turpentine, camphor, solutions of sublimate, &c.

CIMICIFUGA, in botany, a genus of the polyandria order, in the diœcia class of plants. The male calyx is almost pentaphyllous; there is no corolla; the stamina are 20 in number: the female calyx is almost pentaphyllous; no corolla: the stamina 20, and barren; the capsules from four to seven, polyspermous. There is but one species; it is a native of the Carpathian mountains. It has obtained the name of cimicifuga, or bugbane, from its property of driving away those insects.

CIMOLITE, a species of white earth, found in some of the Grecian islands, where it is used for whitening stuffs. It is mentioned by Pliny under the name of cimolia, and in more modern authors it is called cimolia terra. Colour pearl-grey; when exposed to the air it becomes reddish. Texture earthy, fracture uneven, opaque, does not stain, but adheres strongly to the tongue. It is soft, and broken with difficulty: specific gravity is 2.000; and it becomes white before the blow-pipe.

CINCHONA, a genus of the monogynia order, in the pentandria class of plants, and in the natural method ranking with those plants, the order of which is dubious. The corolla is funnel-shaped, with a woolly summit; the capsule inferior, bilocular, with a parallel partition. There are nine species.

CINERARIA, a genus of the class and order syngenesia polygamia superflua. The calyx is simple, many-leaved, equal; pappus simple; receptacle naked. There are 41 species, most of them ornamental plants, and natives of the Cape.

CINNABAR, an ore of mercury, consisting of that metal united with sulphur. The principal use of cinnabar, is in painting; in which art it is known under the name of vermilion.

CINNAMON. See Laurus.

CINQUE *Ports*, five havens that lie on the east part of England towards France, thus called by way of eminence, on account of their superior importance, as having been thought by our kings to merit a particular regard, for their preservation against invasions. Hence they have a particular policy, and are governed by a keeper, with the title of a lord warden of the Cinque Ports, which office belongs to the constable of Dover; and their representatives are called Barons of the Cinque

[illegible]se five ports are Dover, Hastings, Rom[illegible] Hythe, and Sandwich; to which Winchelsea and Rye have been since added.

CIPHER, denotes certain secret characters *used in writing letters that contain some secret*, not to be understood but by those between whom the cipher is agreed on. There are several kinds of ciphers according to Lord Bacon; as the simple, those mixed with nonsignificants, those consisting of two kinds of characters, wheel-ciphers, key-ciphers, word-ciphers, &c.

CIRCÆA, *enchanter's nightshade*, a genus of the monogynia order, in the diandria class of plants, and in the natural method ranking under the 48th order, aggregatæ. There are two species, one of which is a native of Britain, and the other of Germany. They are low herbaceous plants with white flowers.

CIRCLE, in geometry, a plane figure comprehended by a single curve line, called its circumference; in which right lines drawn from a point in the middle, called the centre, are equal to each other.

The area of the circle is found by multiplying the circumference by the *fourth part* of the diameter; or half the circumference by half the diameter.

Circles, and similar figures inscribed in them, are always as the squares of the diameters; so that they are in a duplicate ratio of their diameters, and consequently of their radii.

A circle is equal to a triangle, the base of which is equal to the periphery, and its altitude to its radius; circles therefore are ratio compounded of the peripheries and the radii.

To find the proportion of the diameter of a circle to its circumference. Find, by continual bisection, the sides of the inscribed polygon, till you arrive at a side subtending any arch, however small; this found, find likewise the side of a sim[illegible] circumscribed polygon; multiply each by [illegible] number of the sides of the polygon, by which you will have the perimeter of each. The ratio of the diameter to the periphery of the circle will be greater than that of the same diameter to the perimeter of the circumscribed polygon, but less than that of the inscribed polygon. The difference of the two being known, the ratio of the diameter to the periphery is easily had in numbers very nearly, though not justly, true. Thus Archimedes fixed the proportion at 7 to 22.

CIRCLES, *druidical*, in British topography, a name given to certain ancient inclosures, formed by rude stones, circularly arranged.

These, it is now generally agreed, were temples, and many writers think also places of solemn assemblies for councils or elections, and seats of judgment.

CIRCUIT, in law, signifies the journey, or progress, which the judges take twice every year, through the several counties of England and Wales, to hold courts and administer

justice, where recourse cannot be had to the King's courts at Westminster; hence England is divided into six circuits, viz. the home circuit, Norfolk circuit, Midland circuit, Oxford circuit, Western circuit, and Northern circuit. In Wales there are but two circuits, North and South Wales.

CIRCULATION *of the blood*, the natural motion of the blood in a living animal, whereby that fluid is alternately carried from the heart to all parts of the body by the arteries, and returned from the same parts to the heart by the veins.

CIRCUMFERENCE, the curve line which bounds a circle; and otherwise called a periphery, the boundary of a right-lined figure being expressed by the term perimeter. The circumference of every circle is supposed to be divided into 360 degrees. The angle at the circumference of a circle is double that at the centre.

CIRCUMFERENTOR, an instrument used by surveyors for taking angles. See SURVEYING.

CIRCUMSCRIBED *hyperbola*, one of Sir Isaac Newton's hyperbolas of the second order, that cuts its asymptotes, and contains the parts cut off within its own space.

CIRCUMSCRIBING, in geometry, denotes the describing a polygonous figure about a circle, in such a manner that all its sides shall be tangents to the circumference. Sometimes the term is used for the describing a circle about a polygon, so that each side is a chord; but in this case it is more usual to say the polygon is inscribed, than the circle is circumscribed.

CIRCUMVALLATION, or *line of circumvallation*, in the art of war, is a trench bordered with a parapet, thrown up quite round the besieger's camp, by way of security against any army that may attempt to relieve the place, as well as to prevent desertion. See FORTIFICATION.

CISSAMPELOS, a genus of the monadelphia order in the diœcia class of plants; and in the natural method ranking under the 11th order, sarmentaceæ. There are three species.

CISSOID, in geometry, a curve of the second order, first invented by Diocles and called after his name.

CISSUS, the wild grape, a genus of the monogynia order in the tetrandria class of plants, ranking in the natural method under the 46th order, hederaceæ. There are 15 species, natives of Jamaica and some of the adjacent islands, also of some parts of the East Indies. The branches have tendrils at their joints by which they climb up trees to a considerable height.

CISTUS, the *rock rose*, a genus of the monogynia order, in the polyandria class of plants, ranking in the natural method under the 20th order, rotaceæ. There are 66 species, mostly natives of the southern parts of Europe. They are very beautiful evergreen shrubs, and very ornamental in gardens. The flowers are white, purple, and yellow. They are propagated by seeds or cuttings. Gum labdanum is obtained from one of the species in the Levant.

CITADEL, a place fortified with four, five, or six bastions, built on a convenient ground near a city, that it may command it in case of a rebellion.

CITHAREXYLUM, in botany, *English fiddle-wood*, a genus of the didynamia angiospermia class and order. Natural order of personatæ. There are five species; all natives of the West Indies.

CITRIC *acid*. Acid of limes. It has been found nearly unmixed, with other acids, not only in lemons, oranges, and limes, but also in the berries of *vaccinium oxycoccus*, or cranberry, *vaccinium vitis idæa*, or red whortleberry, of birdcherry, nightshade, hip, in unripe grapes and tamarinds. Gooseberries, currants, bilberries, beamberries, cherries, strawberries, cloudberries, and raspberries, contain citric acid mixed with an equal quantity of malic acid. The onion yields citrate of lime.

CITRUS, the citron, orange, and lemon tree a genus of the polydelphia class and the icosandria order of plants. The calyx is quinquefid; the petals oblong, and five in number; the antheræ are 20, filaments united into various bodies; fruit, nine-celled. There are five species, with many varieties, viz.

I. Citrus aurantium, the orange: of which the varieties are, 1. Seville orange. This is a very handsome tree, and the hardiest of any. The fruit is large, rough-rinded, and sour, of excellent quality for economical uses. 2. The China orange. This has a smooth, thin rind, sweet fruit, of which there are several varieties in warm countries. 3. The forbidden-fruit tree, very much resembles the common orange-tree; but the fruit is larger. 4. The horned orange is a tree of moderate size, producing fruit which divide, and the rind runs out into divisions like horns. 5. The hermaphrodite orange is a common sized tree, producing fruit shaped partly like an orange, and partly like a citron. 6. The dwarf orange tree, or nutmeg-orange, growing two or three feet high; the fruit is very small.

II. Citrus medica, the citron-tree. The varieties are, 1. Citron-tree with sour fruit 2. with sweetish fruit; 3. with long fruit, 4. with warted fruit; 5. with recurved fruit; and 6. with blotched leaves.

The lemon-tree is accounted a variety of the citron. Of this there are no fewer than eleven varieties.

These are the most remarkable varieties of the species of citrus; but besides these there are several others.

1. Citrus trifoliata, is a thorny shrub, growing naturally in Japan, where it is likewise known by the names of gees, and karatals banna.

2. Citrus decumana, or shaddock, which derives its name from captain Shaddock, who brought it from the East Indies.

3. Citrus japonica, the fruit of which is no larger than a cherry, but very sweet and pleasant.

CIVIL *law*, is properly the peculiar law of each state, country, or city; but what is usually meant by the civil law, is a body of laws composed out of the best Roman and Grecian laws, compiled from the laws of nature and nations, and for the most part received and observed throughout all the Roman dominions for about 1200 years.

In England it is used in the ecclesiastical courts, in the courts of the admiralty, and in

the two universities; yet in all these it is restrained and directed by the common law.

Civil *year* is the legal year, or annual account of time, which every government appoints to be used within its own dominions; and is so called in contradistinction to the natural year, which is measured by the revolution of the heavenly bodies.

CIVILIAN, in general, denotes something belonging to the civil law, but more especially the doctors and professors of it are called civilians. Of these we have a college or society in London, known by the name of doctors-commons.

CLAMP, *in a ship*, denotes a piece of timber applied to a mast or yard, to prevent the wood from bursting; and also a thick plank lying fore and aft under the beams of the second deck.

Clamp is likewise the term for a pile of unburned bricks, built up for burning.

CLAMPING, in joinery, is the fitting a piece of board with the grain, to another piece of board cross the grain to prevent its warping.

CLARIFICATION, is the separation, by chemical means, of any liquid from substances suspended in it, and rendering it turbid.

CLARINET, in music, a wind instrument of the reed kind, the scale of which, though it includes every semitone within its extremes, is virtually defective. Its lowest note is E, below the F cliff, from which it is capable, in the hands of good solo performers, of ascending more than three octaves.

CLARO *obscuro*, or Clair *obscure*, in painting, the art of distributing to advantage the lights and shadows of a piece, both with regard to the easing of the eye, and the effect of the whole piece.

CLASS, a term given to the general divisions of a subject: thus in the Linnæan system, animals and plants are divided into classes.

CLATHRUS, in botany, a genus of roundish fungi; the substance of which is full of holes, like the meshes of a net. There are 7 species.

CLAVARIA, *club top*, a genus of the cryptogamia class of plants, and of the order of fungi; and in the 58th of the natural method. According to Miller, the whole genus of clavaria ought to be reckoned in the tribe of the zoophytes; and therefore he classes them among the vermes. Other naturalists, however, have not been able to discern any thing of an animal nature in the clavaria. The species are: 1. Clavaria bemotades, or the oak leather club-top, resembling tanned leather. 2. Clavaria militaris.

CLAVICLES, in anatomy, are two bones situated transversely and a little obliquely opposite to each other, at the superior and anterior part of the thorax, between the scapula and sternum.

CLAUSE signifies an article, or particular stipulation, in a contract, a charge or condition in a testament, &c.

Thus we say, a derogatory clause, a penal clause, saving clause, codicillary clause, &c.

CLAY. The clays are opaque and non crystallized bodies, and of dull fracture. They form with water a plastic paste, possessing considerable tenacity, which hardens with heat, so as to strike fire with steel. Marles and chalks also soften in water, but their paste is not tenacious, nor does it acquire a siliceous hardness in the fire. The affinity of the clays for moisture is manifested by their sticking to the tongue, and by the intense heat necessary to make them perfectly dry. The odour ascribed to clays breathed upon, is due [illegible]he oxide of iron mixed with them. Absolutely pure clays emit no smell.

Of the different kinds of clay at present known, the following are the principal. 1. *Porcelain clay*, derived chiefly from the decomposition of feldspar, and containing silica and alumina, with traces of oxide of iron. 2. *Marl clay*, which contains a portion of carbonate of lime, and is much used in making pale coloured bricks. 3. *Pipe clay*, which is very plastic, requiring a high temperature for fusion, and used for tobacco-pipes and white pottery. 4. *Potters' clay*, which is of a reddish colour; it is used for coarse pottery, and, mixed with sand, for bricks and tiles.

CLAYTONIA, in botany, a genus of the pentandria monogynia class of plants, the flower of which consists of five erect, large petals; the fruit is a roundish unilocular capsule, containing three roundish seeds. There are two species.

CLEF, or Cliff, in music, a mark set at the beginning of a song, to shew the key in which the piece is to be performed; or it is a letter marked on any line which explains the rest.

CLEMATIS, virgin's bower, in botany, a genus of the polyandria polygynia class of plants, the flower of which consists of four oblong lax petals. There is no pericarpium, but a small receptacle contains several roundish seeds, crowned with a slender filament. There are 21 species, chiefly climbing shrubs.

CLEOME, a genus of the siliquosa order, in the tetradynamia class of plants, and in the natural method ranking under the 25th order, putamineæ. There are 15 species; all natives of warm climates, except two. They are herbaceous plants, rising from one to two feet high; and are adorned with flowers of various colours.

CLEPSYDRA, a water-clock, or instrument to measure time by the fall of a certain quantity of water.

There wer[illegible]any kinds of clepsydræ among the ancients; but they all had this in common, that the water ran generally through a narrow passage, from one vessel to another; and in the lower was a piece of cork or light wood, which, as the vessel filled, rose up by degrees, and shewed the hour.

CLERK, a word originally used to denote a learned man, or man of letters: whence the term became appropriated to churchmen, who were from thence called clerks or clergymen; the nobility and gentry being usually bred up to the exercise of arms, and none left but the ecclesiastics to cultivate the sciences. The term is now applied to persons in different offices of the law and government, and also to those who keep merchants' accounts.

CLERODENDRUM, a genus of the didynamia angiospermia class of plants. There are eight species, natives of the East Indies.

CLETHRA, a genus of the monogynia order in the decandria class of plants, and in the

natural method ranking under the 18th order, bicornes. There are four species, of which the most remarkable is, clethra alnifolia, a native of Virginia and Carolina, where it grows in moist places, and near the sides of rivulets, rising near eight or ten feet high. This plant bears the open air in Britain, and is one of the most beautiful flowering shrubs. It is propagated by layers, but they are generally [illegible]o years before they take root.

CLIBADIUM, a genus of the monœcia pentandria class and order. There is only one species, a native of Surinam.

CLIFFORTIA, a genus of the polyandria order, in the diœcia class of plants: and in the natural method ranking under the 38th order, tricoccæ There are nineteen species, all natives of Africa; they require to be kept in a green-house when cultivated in this country.

CLIMATES, in geography, spaces upon the surface of the terrestrial globe, contained between two parallels, so far distant from each other, that the longest day on one parallel differs half an hour from the longest day on the other. See GEOGRAPHY.

CLINCH, in the sea-language, that part of a cable which is bent about the ring of the anchor, and then made fast.

CLINIC *medicine*, particularly used for the method of visiting and treating sick persons in bed, and the more exact discovery of all the symptoms of their disease.

CLINOPODIUM, *field-basil*, a genus of the gymnospermia order, in the didynamia class of plants; and in the natural method ranking under the 41st order, asperifoliæ. There are five species, all herbaceous plants, growing from one to two feet high.

CLITORIA, a genus of the decandria order in the diadelphia class of plants; and in the natural method ranking under the 32d order, papilionaceæ. There are five species, all herbaceous perennials, or annuals, of the kidney-bean kind, growing naturally in both the Indies. The flowers, which are elegant, stand singly, each on its proper footstalk. They are large, and generally of a deep blue, but sometimes of a white colour.

CLOCK. See HOROLOGY.

CLOFF, that in which any goods are put for the convenience of carriage; as the bags of pepper or hops, the ba[illegible]ls of butter, soap, &c.

CLOUD. A mass of vapour, more or less opaque, formed and sustained at considerable heights in the atmosphere, probably by the joint agencies of heat and electricity. The first successful attempt to arrange the diversified forms of clouds, under a few general modifications, was made by Luke Howard, Esq. We shall give here a brief account of his ingenious classification.

The *simple* modifications are thus named and defined: 1. *Cirrus.* Parallel, flexuous, or diverging fibres, extensible in any or in all directions. 2. *Cumulus.* Convex or conical heaps, increasing upwards from a horizontal base. 3. *Stratus.* A widely extended, continuous horizontal sheet, increasing from below.

The *intermediate* modifications which require to be noticed are, 4. *Cirro-cumulus.* Small well-defined roundish masses, in close horizontal arrangement 5. *Cirro-stratus.* Horizontal, or slightly inclined masses, attenuated towards a part or the whole of their circumference, bent downward, or undulated, separate or in groups, consisting of small clouds having these characters.

The *compound* modifications are, 6. *Cumulo-stratus.* The cirro-stratus, blended with the cumulus, and either appearing intermixed with the heaps of the latter, or superadding a wide-spread structure to its base.

7. *Cumulo-cirro-stratus,* vel *Nimbus.* The rain cloud. A cloud or system of clouds from which rain is falling. It is a horizontal sheet, above which the cirrus spreads, while the cumulus enters it laterally and from beneath.

The *cirrus* appears to have the least density, the greatest elevation, the greatest variety of extent and direction, and to appear earliest on serene weather, being indicated by a few threads pencilled on the sky. Before storms they appear lower and denser, and usually in the quarter opposite to that from which the storm arises. Steady high winds are also preceded and attended by *cirrus* streaks, running quite across the sky in the direction they blow in.

The cumulus has the densest structure, is formed in the lower atmosphere, and moves along with the current next the earth. A small irregular spot first appears, and is, as it were, the nucleus on which they increase. The lower surface continues irregularly plane, while the upper rises into conical or hemispherical heaps; which may afterwards continue long nearly of the same bulk, or rapidly rise into mountains. They will begin, in fair weather, to form some hours after sunrise, arrive at their maximum in the hottest part of the afternoon, then go on diminishing and totally disperse about sunset. Previous to rain, the cumulus increases rapidly, appears lower in the atmosphere, and with its surface full of loose fleeces or protuberances. The formation of large cumuli to leeward in a strong wind, indicates the approach of a calm with rain. When they do not disappear or subside about sunset, but continue to rise, thunder is to be expected in the night. The *stratus* has a mean degree of density, and is the lowest of clouds, its inferior surface commonly resting on the earth or water. This is properly the cloud of night appearing about sunset. It comprehends all those creeping mists, which in calm weather ascend in spreading sheets, (like an inundation of water), from the bottom of valleys, and the surfaces of lakes and rivers. On the return of the sun, the level surface of this cloud begins to put on the appearance of cumulus, the whole at the same time separating from the ground. The continuity is next destroyed, and the cloud ascends and evaporates, or passes off with the appearance of the nascent cumulus. This has long been experienced as a prognostic of fair weather.

The *cirrus* having continued for some time increasing or stationary, usually passes either to the cirro-cumulus or the cirro-stratus, at the same time descending to a lower station in the atmosphere. This modification forms a very beautiful sky; is frequent in summer, an attendant on warm and dry weather. The *cirro-stratus*, when seen in the distance, frequently gives the idea of shoals of fish. It precedes

wind and rain; is seen in the intervals of storms; and sometimes alternates with the cirro-cumulus in the same cloud, when the different evolutions form a curious spectacle. A judgment may be formed of the weather likely to ensue by observing which modification prevails at last. The solar and lunar *halos*, as well as the parhelion and paraselene, (mock sun and mock moon,) prognostics of foul weather, are occasioned by this cloud. The cumulo-stratus precedes, and the nimbus accompanies rain.

CLUPEA, or *herring*, in ichthyology, a genus belonging to the order of abdominales. There are 11 species, of which the following are the principal.

1. The clupea harengus, or common herring, has no spots, and the under jaw is longer than the upper one. A herring dies immediately after it is taken out of the water; whence the proverb, As dead as a herring. Herrings are found from the highest northern latitudes yet known, as low as the northern coasts of France. They are met with in vast shoals on the coast of America, as low as Carolina. The great winter rendezvous of the herring is within the arctic circle. An immense number of them begin to appear off the Shetland isles in April and May; but these are only the forerunners of the grand shoal which comes in June; and their appearance is marked by certain signs, by the numbers of birds which follow to prey on them.

The first check this army meets with in its march southward is from the Shetland isles, which divide it into two parts; one wing takes to the east, the other to the western shores of Great Britain, and fill every bay and creek with their numbers; the former pass on towards Yarmouth, the great mart of herrings; they then pass through the British Channel, and disappear. Those which go towards the west, proceed to the north of Ireland: here they meet with a second interruption, and are obliged to make a second division; one party going to the western side, and being soon lost in passing into the Atlantic, the other into the Irish sea.

They are full of roe in the end of June, and continue in perfection till the beginning of winter, when they deposit their spawn. The young herrings approach the shores in July and August, and are then from half an inch to two inches long.

2. The clupea sprattus, or sprat, has 13 rays in the back fin. It is a native of the European seas, and has a resemblance to the herring, but is smaller. The season for them is from November to March.

3. The clupea encrasiolus, or anchovy, has the upper jaw longer than the under one, and is about three inches long. They are taken in the Mediterranean, and brought here and pickled.

4. Clupea alosa, the shad, has a forked snout, and black spots on the sides. In Great Britain the Severn affords this fish in higher perfection than any other river. It makes its first appearance there in May, but in very warm seasons in April.

CLUYTIA, in botany, in memory of Augerius Clutius, professor of botany at Leyden, a genus of the dioecia gynandria class and order. Essential character: calyx five leaved; corolla five-petalled; female, styles three; capsule three-celled; seed one. There are 10 species, all natives of hot climates.

CLYPEOLA, in botany, a genus of the tetradynamia siliculosa class and order. Natural order of siliquosæ. Essential character: silicle emarginate, or biculate, compressed, flat, deciduous. There are three species. These are low plants that have little beauty, [illegible] are preserved chiefly in botanic gardens.

CLYSTER is a liquid remedy to be injected chiefly at the anus into the larger intestines.

CNEORUM, *widow wail*, a genus of the monogynia order, in the triandria class of plants, ranking in the natural method under the 38th order, tricoccæ. There is only one species, which is a small evergreen, and very ornamental shrub, with simple leaves and yellow flowers. It is propagated from seeds.

CNICUS, *blessed thistle*, a genus of the polygamia æqualis order, in the syngenesia class of plants, in the natural method ranking under the 49th order compositæ. There are nine species, of which the only one remarkable is that called carduus benedictus. It is an annual plant, and flowers in June and July. The leaves are bitter, and a strong decoction from this plant produces vomiting. It is now little used in medicine.

COAGULATION, in chemistry, the rendering a fluid body in some degree solid by exposure to cold, or by the addition of something by which it is decomposed.

COAK, a hard sonorous substance, the residue of coal when subjected to destructive distillation. It is properly charcoal containing the earthy ingredients of the coal, and the process of charring it is conducted after the same manner as that of wood. It is chiefly used by iron and brass founders, when an intense heat is required; also for smelting iron ore, and for operations in which smoke would be detrimental, as in the drying of malt, and in the manufacture of most articles of confectionary.

COAL. This very important order of combustible minerals, is divided by Professor Jameson into the following species and sub-species:—

Species 1. Brown coal.

Species 2. Black coal, of which there are four sub-species; slate coal, cannel-coal, foliated coal, and coarse coal.

1. *Slate coal.* Its colour is intermediate, between velvet-black, and dark greyish black. It has sometimes a peacock-tail tarnish. It occurs massive, and in columnar and egg-shaped concretions. It has a resinous lustre, principal fracture slaty; is brittle, burns longer than cannel coal; cakes more or less, and leaves a slag.

2. *Cannel coal.* Colour between velvet and greyish black. Massive. Resinous lustre; fracture flat conchoidal, or even. Hardness as in the preceding. Brittle It is found in different parts of England, and also in Scotland; and has been worked on the lathe into drinking vessels, snuff-boxes, &c.

3. *Foliated coal.* Colour velvet black, sometimes with iridescent tarnish. Massive, and in lamellar concretions. Resinous or resplendent lustre; softer than cannel coal; between brittle and sectile, and easily broken.

It occurs in the coal formations in this and other countries.

4. *Coarse coal.* Colour dark greyish black, inclining to brownish black. Massive, and in granular concretions. Glistening lustre; fracture imperfect scaly; hardness as above, and easily frangible. It occurs in the German coal formations.

Species 3d. *Glance coal,* of which the Professor gives two sub-species. *Pitch-coal,* and Glance-coal. 1. *Pitch-coal.* Colour, velvet black. Massive, or in plates and botroidal branches, with a woody texture. Splendent and resinous: fracture, large perfect conchoidal. Brittle; does not soil; burns with a greenish flame; occurs along with brown coal in beds, and is found in the isles of Sky and Faroe. It is used for fuel, and for making vessels and snuff-boxes.

2. *Glance-coal,* of which we have four kinds, conchoidal, slaty, columnar, [illegible] fibrous. The conchoidal has an iron-black colour, inclining to brown, with sometimes a tempered steel tarnish. Massive and vesicular. Splendent, shining, and imperfect metallic lustre. Fracture flat conchoidal; hardness as above; brittle and easily frangible; burns without flame or smell, and leaves a white ash.

Slaty glance coal. Colour, iron-black. Massive. Lustre, shining and imperfect metallic. Principal fracture, slaty; coarse fracture, imperfect conchoidal. It is found in Spain, in Switzerland, England, Scotland, and Ireland. In this country it is called blind coal.

Columnar glance coal. Colour, velvet-black, and greyish black. Massive, disseminated, and in prismatic concretions. Lustre, glistening, and imperfect metallic. Fracture, conchoidal; burns without flame or smoke, and is found in several parts of Scotland.

Fibrous coal. Colour, dark greyish-black. Massive, in thin layers, and in fibrous concretions. Lustre, glimmering, or pearly. It soils strongly, is soft, passing into friable; and burns without flame, but some varieties scarcely yield to the most intense heat. It is found in the different coal fields of Great Britain. Its fibrous concretions distinguish it from every other kind of coal.

COASTING, that part of navigation where the places assigned are not far distant, so that a ship may sail in sight of land, or within soundings between them. In this there is only required a good knowledge of the land, the use of the compass and lead, or sounding line.

COAT *of arms,* in heraldry, a surcoat reaching to the waist, open at the sides, and ornamented with armorial bearings, worn by the ancient knights in times of war, or at tournaments, over their armour, being the principal characteristic by which they were distinguished from one another, the face being covered with the helmet.

COATING, in chemistry, is used principally for the purpose of defending certain vessels from the immediate action of fire; thus, glass retorts, and the inside of some furnaces, are coated with various compositions.

COBALT. See CHEMISTRY.

COCCINELLA, in zoology, a genus of insects of the order of coleoptera. The females deposit their eggs, which turn to small larvæ, slow in their process, and enemies to the plant-louse. Of all the different larvæ of the coccinella, the most curious is the white hedgehog; a name given it on account of the singularity of its figure, and the tufts of hair which render it remarkable. After a fortnight it settles on one spot, and, without parting with its fur, turns to a chrysalis: three weeks after which it becomes a coccinella.

COCCOLOBO, a genus of the trigynia order, in the octandria class of plants, and in the natural method ranking under the 12th order, holoraceæ. There are 19 species: the most remarkable is that called the uvifera, or sea-side grape. It grows upon the sandy shores of most of the West India islands.

COCCULUS *Indicus,* the name of a poisonous berry, supposed to be used by brewers in their malt liquors, particularly in porter, to give it an intoxicating quality. But as the use of it is forbidden by the laws of the land, it would be unfair to impute the practice of it to any respectable house.

COCCUS, in zoology, a genus of insects belonging to the order of hemiptera. The rostrum proceeds from the breast: the belly is bristly behind; the wings of the male are erect; and the female has no wings.

There are about fifty species of this insect, extremely fertile, and troublesome in hot houses and green houses. The most important species is the coccus cacti, a native of the warmer parts of America. This is the famous cochineal animal, so highly valued in every part of the world for the incomparable beauty of its red colour, which it readily communicates to wool and silk, but with much more difficulty to linen and cotton.

The cochineal insect may, in some circumstances, be compared to the silk-worm, particularly in the manner of depositing its eggs. The insects destined for this purpose are taken at a proper time of their growth, and put into a box well closed, and lined with a coarse cloth, lest any of them should be lost; and in this confinement they lay their eggs and die. The box is kept close till the time of placing the eggs on the nopal, when, if any motion is perceived, it is a sufficient indication that the animalcule has life, though the egg is so minute as hardly to be perceived; and this is the seed placed on the foliage of the cactus cochenilifer, or Indian fig, known to the Spaniards by the name of nopal, the quantity contained in the shell of a hen's egg being sufficient for covering a whole plant.

COCHINEAL. See the preceding article.

COCHLEARIA, *scurvy-grass,* a genus of the siliculosa order, in the tetradynamia class of plants; and in the natural method ranking under the 39th order, siliquosa. The silicula is emarginated, turgid, and scabrous; with the valves gibbous and obtuse. There are eight species.

COCK. See PHASIANUS.

COCKET is a seal belonging to the King's Custom-house, or rather a scroll of parchment sealed and delivered by the officers of the customs to merchants, as a warrant that their merchandises are customed. It is also used for the office where goods, transported, were first entered and paid their custom, and had a cocket or certificate of discharge.

COCKPIT, in a man of war, a place on the

lower floor, or deck, abaft the main-capstan, lying between the platform and the steward's room, where are partitions for the purser, surgeon, and his mates.

COCKSWAIN, or **COXSON**, an officer on board a man of war, who has the care of the barge and all things belonging to it, and must be also ready with his crew to man the boat on all occasions: he sits at the stern of the boat and steers.

COCOS, in botany, a genus belonging to the natural order of palmæ. It is of the monœcia hexandria class. There are five species, the principal is,

Cocos nucifera, the cocoa-nut tree. It frequently rises 60 feet high. The body of the trunk, generally leans to one side, occasioned by the great weight of nuts it sustains when young. The leaves or branches are often 14 or 15 feet long, about 28 in number, of a yellow colour, straight and tapering. When the kernel begins to grow, it incrusts the inside of the nut with a bluish, jelly-like substance: this hardens as it increases, and becomes as white as snow, and of the flavour of a filberd. The quantity of liquor in a full-grown nut is frequently a pint and upwards. The husky tegument of the nut consists of strong, tough, stringy filaments, which resemble coarse oakum. The leaves are wrought into brooms, hammocks in form of nets, mats, sacks, and other useful utensils.

COD. See GADUS.

CODE, a collection of the laws and constitutions of the Roman emperors, made by order of Justinian. The code is accounted the second volume of the civil law, and contains 12 books.

CODICIL. See WILL.

COEFFICENTS, in algebra, such numbers, or given quantities, as are put before letters, or unknown quantities, into which letters they are supposed to be multiplied. See ALGEBRA.

CŒLIAC *Artery*. See ANATOMY.

COFFEA, the *coffee-tree:* a genus of the monogynia order, in the pentandria class of plants, and in the natural method ranking under the 47th order, stellatæ. There are 10 species, but that which is most worthy of attention is a native of Arabia Felix. The coffea Arabica seldom rises more than 16 or 18 feet in height; the main stem grows upright, and is covered with a light-brown bark; the branches are produced horizontally and opposite, crossing each other at every joint. The leaves also stand opposite; and when fully grown are about four or five inches long, and two broad in the middle, decreasing towards each end; the borders are waved, and the surface is of a lucid green. The flowers are produced in clusters at the root of the leaves, sitting close to the branches; they are of a pure white, and have a grateful odour. The fruit resembles a cherry. It grows in clusters, and is ranged along the branches under the axillæ of the leaves.

The coffee-tree is cultivated in Arabia, Persia, the East Indies, the isle of Bourbon, and several parts of America. It is also raised in botanic gardens in several parts of Europe.

COFFER, in fortification a hollow lodgment athwart a dry moat, from six to seven feet deep, and from sixteen to eighteen broad, the upper part being made of pieces of timber, raised two feet above the level of that moat, which little elevation has hurdles, laden with earth, for its covering, and serves as a parapet with embrasures.

COHESION, or attraction of cohesion, is that power by which the particles of bodies are held together. The absolute cohesion of solids is measured by the force necessary to pull them asunder. Heat is excited at the same time. At the iron cable manufactory of Captain Brown, a cylindrical bar of iron, 1¼ inch diameter, was drawn asunder by a force of 43 tons. Before the rupture, the bar lengthened about five inches, and the section of fracture was reduced nearly three-eighths of an inch. About this part a degree of heat was generated, which, according to Mr. Barlow of Woolwich, rendered it unpleasant, if not in a slight degree painful, to grasp the bar in the hand. The same thing is shewn in a greater degree in wire-drawing. When the force is applied to compress the body, it becomes shorter in the direction of the force, which is called the *compression:* and the area of its section at right angles to the force, expands. The cohesion, calculated from the transverse strength, is as near, or perhaps nearer, the real cohesion, than that obtained by pulling the body asunder. The cohesive force of metals is much increased by wire-drawing, rolling, and hammering them.

COINING, or COINAGE, is the making of the metallic currency of the country. The method of conducting this process in the Royal Mint has, within the last few years, undergone a complete reformation.

The machinery, which is the invention of Messrs. Bolton and Watt, Morrison, Barton and others, is, for the most part, worked by steam; and is so constructed as to secure the principles of economy, accuracy, and despatch, in an astonishing degree.

The newly constructed melting furnace of Mr. Morrison, it is said, is capable of melting, with ease, 10,000 lbs. troy of silver daily; this was done for several months, during the recoinage, in 1817. The beautiful invention of Mr. Barton for reducing the plates, out of which the blanks are to be cut, to a uniform thickness, has entirely superseded the old tedious, and clumsy process of filing each individual blank to the standard weight. But the most ingenious piece of the mint machinery is the coining press.

This press is worked by means of a series of machinery placed in an apartment over the coining room, and connected with the steam engine. It has adapted to it a contrivance by which it feeds itself with the blanks to be impressed, and removes them the instant they have received the impression; while at the same time it acts as a register, and keeps an unerring account of the number of pieces struck. There are eight of these presses fixed in the coining room; and by the aid of this new machinery, four boys are capable of striking 20,000 pieces of money in an hour.

COIX, *Job's tears*. a genus of the triandria order, in the monœcia class of plants; and in the natural method ranking under the 4th order, gramina. There are three species, the principal of which the coix lacryma, is a native

of the East Indies, and frequently cultivated in Spain and Portugal.

COLCHICUM, meadow saffron: a genus of the trigynia order, in the hexandria class of plants, and in the natural method ranking under the 9th order, spathaceæ.

There are three species; all bulbous-rooted perennials, possessing the singular property of their leaves appearing at one time, and their flowers at another.

COLD. When caloric combines with our bodies, or separates from them, we experience, in the first case, the sensation of heat, in the second, cold. When the hand is put upon a hot iron, part of the caloric leaves the iron, and enters the hand; this produces the sensation of heat. On the contrary, when the hand is put upon a lump of ice, the caloric rapidly leaves the hand and combines with the ice; this produces the sensation of cold. The sensation of heat is occasioned by caloric passing into our bodies; the sensation of cold by caloric passing out of our bodies. We say that a body is hot, when it communicates caloric to the surrounding bodies; we call it cold, when it absorbs caloric from other bodies.

The opinion that cold is a real substance seems to have gained considerable ground from the experiments of the members of the Academy del cimento at Florence, which were afterwards revived by Pictet of Geneva, with perfect success. But the concentration of cold in the focus of a speculum; although it appears to establish, or at least to render probable, the distinct and material existence of cold, is accounted for by modern philosophers on a different principle. The true solution of this problem is derived from the abstraction of that return of heat which the thermoscope mirror had derived from the one which is operated on by the cooling body, and now participating in its radiating tension. Thus, also, a black body placed in the focus of one mirror, would diminish the light in the focus of another; the eye, according to Sir H. Davy, being to the rays producing light, a *measure* similar to that which the thermometer is to rays producing heat. See Congelation.

COLDENIA, a genus of the tetragynia order, in the tetrandria class of plants; and in the natural method ranking among those of the dubious order. There is but one species, a native of India.

COLEOPTERA, among zoologists, the first order of insects, comprehending all those with four wings, the external pair of which are hard, rigid, and opake, and form a kind of case for the interior pair: the mouth consists of two transverse jaws.

According to the Linnæan system, there are about 56 genera in this order.

COLIC, in medicine, a severe pain in the lower venter, so called, because the disorder was formerly supposed to be seated in the colon.

COLISEUM, or Colisæum, in ancient architecture, an oval amphitheatre at Rome, built by Vespasian, wherein were statues set up, representing all the provinces of the empire: in the middle of which stood that of Rome, holding a golden apple in her hand.

COLLEGE, an assemblage of several bodies or societies, of several persons into one society. Among the Romans there were the colleges of augurs, managers of the public games, carpenters, potters, lock-smiths, engineers, butchers, bakers, and tent makers; each of which had its distinct hall, or place of meeting.

COLLIERS, vessels employed to carry coals from one port to another, principally from the northern parts of England to the capital, and more southern parts, and foreign markets. Their trade is known to be an excellent nursery for seamen.

COLLINSONIA, in botany, a genus of the diandria monogynia class and order. Leaves, ovate, glabrous; stem glabrous. Two species, found in North America.

COLLYRIUM, in pharmacy, a topical remedy for disorders of the eyes.

COLOGNE *earth*, a substance used in painting, much approaching to amber in its structure, and of a deep brown. It has generally been esteemed a genuine earth, but has been discovered to contain a great deal of vegetable matter, and, indeed, is a very singular substance.

COLON, in anatomy, the second of the three large intestines.

Colon, in grammar, a character marked thus, (:) to divide a sentence.

COLONEL, in military matters, the commander-in-chief of a regiment, whether horse, foot, or dragoons.

Colonel, *lieutenant*, the second officer in a regiment, who is at the head of the captains, and commands in the absence of the colonel.

COLONNADE. See Architecture.

COLONY. A colony is a settlement formed by the inhabitants of any nation in some part of the world, unoccupied by any other civilized nation.

COLOPHONY. Colophony, or black resin, is the resinous residuum after the distillation of the light oil, and thick dark reddish balsam, from turpentine.

COLOSSUS, a statue of a gigantic or enormous size. The most famous of this kind was the colossus of Rhodes, made in honour of Apollo, by Chares the disciple of Lysippus. It was 86 feet high, and its thumb so large that few people could embrace it. This statue was placed across the mouth of the harbour at Rhodes, and the ships, in full sail, passed betwixt its legs.

COLOURS, in optics. See Optics.

Colours, in painting. See Painting.

Colours, in heraldry, are red, blue, black, green, and purple, thus distinguished: gules, azure, sable, vert, and purpule; yellow and white called or and argent, are metals.

COLUBER, a genus of serpents. The generic character is, scuta or undivided lamellæ under the abdomen, broad alternate scales under the tail. There are 97 species, the principal of which are: 1. Coluber Berus, or the viper, whose general length is about 18 to 24 inches, though some have been found near three feet; the fangs, which are usually two, are placed on each side the fore part of the upper jaw. The remedy for the bite of the viper, is olive oil, thoroughly rubbed on the wounded part, and about a wine glass full taken internally. The viper is viviparous, and

produces its young towards the close of the summer. It is asserted, that the female admits her young down her throat on sudden surprises.* 2. The cerastes, or horned viper, grows to the length of 12 or 15 inches. It has a pair of horns above the eyes, and is a native of the desarts of Africa, Syria, and Arabia. The general colour is a yellow or reddish brown, with large spots, and the belly of a pale lead colour. 3. Coluber nasicornis, or horned-nose snake, is a native of the interior of Africa, and its bite produces speedy death. It has two horns on the anterior part of the upper jaw. 4. Coluber naja, or cobra de capello, is a native of India, and about the length of three or four feet. The Portuguese call it cobra de capello, or hooded snake, from its appearance when irritated, when it bends the head downward, and seems hooded by the expanded skin of the neck. The Indians deprive it of its fangs, and then carry it about in a basket, making it dance to the sound of music. 5. Coluber aquaticus, or water viper, called in Carolina the water rattle snake, is a large animal, and its bite mortal. It frequents the water, and in summer numbers are seen lying on the branches of trees, watching for birds or fish. 6. Coluber argus, or argus snake, is a large species, above five feet in length. The head is covered with scales, and the teeth are large. The upper part of the animal is of a dusky chesnut colour, and the scales are marked with white specks: the whole body being beautifully marked with transverse rows of red spots. It is a native of Arabia. 7. Coluber natrix, or ringed snake, is common in this country, frequenting woods, moist hedges, and shady places. The general colour is a bluish grey, or pale olive on the upper parts, marked along the sides by black streaks. It is inoffensive, and feeds on frogs, mice, insects, worms, &c. It deposits its eggs in any warm and moist situation in the form of a chain to the number of twelve, fourteen, sixteen, or more. 8. Coluber atrovirens or French snake, is a harmless animal, and nearly resembles the preceding. 9. Coluber constrictor, or black snake is nearly six feet long, and all over of a shining black. It is very useful in killing rats, which it will follow to the tops of houses. It is a native of North America. 10. Coluber austriacus or smooth snake, is found in France and several other parts of Europe, and is very fierce, though the bite is harmless. 11. Coluber gemmatus, or bogle snake is a beautiful species, about sixteen inches long; the colour of the upper parts is blue, with three narrow stripes from head to tail; the two lateral stripes white, and the middle one black, with a row of small white specks resembling a string of beads. 12. The coluber mycterizans, or long-snouted snake, is of a green colour with a yellow line on each side the abdomen. It is about three feet long and about half an inch in diameter. It is a native of North America and feeds on insects. 13. Coluber ahætulla, or iridescent snake, is in general of a blue-green gilded appearance, accompanied by iridescent hues. The length is about three feet and a half, and about three quarters of an inch in diameter. It is a native of India.

COLUMBA, in ornithology, the pigeon, a genus belonging to the order of passeres. There are about 70 species, natives of different countries. The following are the most remarkable:

1. Columba coronata, or great crowned pigeon, about the size of a turkey. The bill is black, and the body of a cinereous blue colour. This species inhabits the Molucca isles and New Guinea, and has been brought to England alive.

2. Columba Malaccensis, the Malacca pigeon is little larger than the house-sparrow. It is a most beautiful species, and the flesh is said to be extremely delicate.

3. Columba migratoria, or pigeon of passage, is about the size of an English wood-pigeon; the bill black: it is red; the head of a dusky blue; the breast and belly of a faint red; above the shoulder of the wing there is a patch of feathers shining like gold; the wing is coloured like the head, having some few spots of black, the tail is very long, and covered with a black feather, under which the rest are white; the legs and feet are red. They come in prodigious numbers from the north to winter in Virginia and Carolina.

4. Columba œnas, or the domestic pigeon, and all its varieties, derive their origin from one species, the stock dove; the English name implying its being the stock or stem, whence the other domestic birds have sprung. It is of a deep bluish ash-colour; the breast dashed with a fine changeable green and purple. The varieties produced from the domestic breed are numerous, and elegant; they are distinguished by names expressive of their several properties, as tumblers, carriers, jacobines, croppers, pouters, runts, turbites, owls, nuns, &c. The most celebrated of these, is the carrier. They are gregarious; lay only two eggs, and breed many times in the year.

5. Columba palumbus, the ring dove or wood pigeon, is a native of Europe and Asia. It is the largest pigeon we have, and might be distinguished from all others by its size alone. The head, back, and covers of the wings, are of a bluish ash-colour; the lower side of the neck and breast are of a purplish red, dashed with ash-colour. This species forms its nest of a few dry sticks in the boughs of trees.

6. Columba passerina, or the ground-dove of Carolina, is about the size of a lark. They fly in great numbers together, and make short flights from place to place, generally lighting on the ground.

7. Columba turtur, or turtle-dove, is a native of India. The irides are of a fine yellow, and the eye-lids encompassed with a beautiful crimson circle. They are very shy, and breed in thick woods, generally of oak; in autumn they migrate into other countries.

COLUMN, in the military art, a long deep file of troops or baggage. The first and second lines of the army as they are encamped, make generally two columns on a march, filing off either from the right or left: sometimes the army marches in four, six, or eight columns, according as the ground will allow: and each column is led by a general officer.

COLUMN. See ARCHITECTURE.

COLUMNEA, a genus of the angiospermia order, in the didynamia class of plants; and in the natural method ranking under the 40th order, personatæ. There are six species, natives of the East and West Indies.

COLURES, in astronomy and geography

two great circles supposed to intersect each other at right angles in the poles of the world, and to pass through the solstitial and equinoctial points of the ecliptic.

COLUTEA, bastard sena; a genus of the decandria order, in the diadelphia class of plants; and in the natural method ranking under the 32d order, papilionaceæ. There are nine species, deciduous flowering shrubs, adorned with many lobed leaves, and butterfly-shaped flowers, of a deep yellow or red colour. They are propagated both by seeds and layers.

COLYMBUS, *diver*, in ornithology, a genus of anseres. This genus includes several species, viz. the divers, guillemots, and grebes; of which the following are the most remarkable.

1. The grylle, or black guillemot, is in length fourteen inches, in breadth twenty-two; the bill is an inch and a half long, straight, slender, and black; the inside of the mouth red; on each wing is a large spot of white. Except in breeding-time, the grylle keeps always at sea; and is very difficult to be shot, diving at the flash of the pan.

2. The troile, or foolish guillemot, weighs 24 ounces; its length is 17 inches, the breadth 27½; the bill is three inches long, black, straight, and sharp pointed; the inside of the mouth yellow; the feathers on the upper part of the bill are short and soft like velvet; from the eye to the hind part of the head is a small division of the feathers; the rest is of a deep mouse-colour. They are found in the northern parts of Scotland, and the cliffs about Scarborough.

3. The septentrionalis, or red-throated diver, is more elegantly shaped than the others. It weighs three pounds. This species breeds in the northern parts of Scotland, on the borders of the lakes.

4. The glacialis, or northern diver, is three feet five inches in length; the breadth four feet eight. This species inhabits several parts of the north of Europe, but it is not often seen on land. The natives of Greenland use the skins for clothing; and the Indians about Hudson's Bay adorn their heads with circlets of their feathers.

5. The immer, or ember-goose, is superior in size to a common goose, and of a dusky colour. This species inhabits the Orkney islands; it is found also in most parts of the north of Europe, and in Switzerland

6. The Chinese diver, supposed to inhabit China. From the various and uncertain accounts of authors, it is not clear what birds the Chinese use for catching fish: the custom, however, of doing it, is manifest, from the relations, of many travellers. The bird used for this purpose has a ring fastened round the middle of the neck, in order to prevent its swallowing: besides this it has a slender long string fastened to it; and, thus accoutred, is taken by its master into his fishing-boat, from the edge of which it is taught to plunge after the fish as they pass by.

7. The cristatus, crested diver, or cargoose, weighs two pounds and a half. Its length is 21 inches, the breadth 30. The cheeks and throat are surrounded with a ruff, of a bright tawny colour, edged with black; the chin is white; the breast and belly are of a silvery white: the outside of the legs are dusky; the inside of a pale green. They frequent the fenny parts of the country, and in Lincolnshire they are called gaunts.

8. The urinator, or tippet-grebe, is somewhat less than the preceding, and is without the crest and ruff. This species is rather scarce in England, but is common in the winter time on the lake of Geneva.

9. The horned grebe is about the size of a teal; weight, one pound; length, one foot; breadth, sixteen inches. It inhabits Hudson's Bay; and first appears in May, about the fresh waters.

COMA *Berenices*, Berenice's hair, in astronomy, a constellation of the northern hemisphere, composed of stars near the lion's tail.

COMARUM, *marsh-cinquefoil*: a genus of the polygamia order, in the icosandria class of plants; and in the natural method ranking under the 35th order, senticosæ. There is but one species, a native of Britain. It grows to the height of about two feet, and the fruit resembles the straw berry.

COMB, an instrument to clean, untangle, and dress, flax, wool, hair, &c. Combs for wool are prohibited to be imported into Britain.

COMB, in a ship, a little piece of timber set under the lower part of the beakhead, near the middle

COMBINATION. The intimate union of the particles of different substances by chemical attraction, so as to form a compound possessed of new and peculiar properties.

COMBINATIONS, in mathematics, denote the alterations or variations, of quantities, letters, sounds, or the like, in all possible ways.

Of the doctrine of Combinations.

1. *When only two are combined.*—One thing admits of no combination. Two, *a* and *b*, admit of only one, viz. *ab*. Three *a*, *b*, *c*, admit of three, *ab*, *ac*, *bc*. Four of six, viz. *ab*, *ac*, *ad*, *bc*, *bd*, *cd*. Five of ten, viz, *ab*, *ac*, *ad*, *ae*, *bc*, *bd*, *be*, *cd*, *ce*, *de*.

Whence the numbers of combinations of two and two only, proceed according to the triangular numbers, 13, 6, 10, 15, 21, &c. which are produced by the continual addition of the original series, 0, 1, 2, 3, 4, 5, &c. And if n be the number of things, the formula for expressing the sum of all their combinations by two's, will be $\frac{n . n-1}{1 . 2}$

Thus, if $n=2$; this becomes $\frac{2 . 1}{\cdot}=1.$

If $n=3$; it is $\frac{3 . 2}{} =3.$

If $n=4$, $\frac{4 . 3}{2} =6$, &c.

2. *When three are combined together.* Three things admit of one order, *a*, *b*, *c*. Four admit of four, viz. *abc*, *abd*, *acd*, *bcd*. Five admit of ten; *abc*, *abd*, *abe*, *acd*, *ace*, *ade*, *bcd*, *bce*, *bde*, *cde*. And so on, according to the first pyramidal numbers, 1, 4, 10, 20, &c. which are formed by the continual addition of the former, or the triangular numbers, 1, 3, 6, 10, &c. And the general formula for any number of combinations, taken by three's is $\frac{n . n-1 . n-2}{1 \quad 2 . \quad 3}$

So, if $n=3$; it is $\frac{3 . 2 . 1}{1 . 2 . 3.}=1$

If $n=4$; it is $\frac{4 . 3 . 2}{6}=4$.

If $n=5$; it is $\frac{5 . 4 . 3 .}{6}=10$.

Proceeding thus, it is found that a general formula for any number n of things, combined by m at each time, is $s =$ $\frac{n}{1} . \frac{\overline{n-1}}{2} . \frac{\overline{n-2}}{3} . \frac{\overline{n-3}}{4}$, &c. continued to m factors or terms, or till the last factor in the denominator be m.

So, in six things, combined by four's, the number of combinations, is

$$\frac{6 . 5 . 4 . 3}{1 . 2 . 3 . 4}=15.$$

3. By adding these together, the sum will be the whole number of possible combinations of n things combined by two's, three's, four's, &c. And all the series, are the co-efficients of the power n of a binomial, wanting only the first two, 1 and n; therefore the sum will be $\overline{1+1}|^{2}-n-1$, or, 2^n-n-1. If the number of things be five then $2^5-6=32-6=26$.

II. *To find the number of changes and alterations which a number of quantities can undergo, when combined in all possible varieties of ways, with themselves and each other, both as to the things themselves, and their order and position.*

One thing admits of one order or position.

Two may be varied four ways, as *aa*, *ab*, *ba*, *bb*.

Three quantities taken by two's may be varied nine ways, as *aa*, *ab*, *ac*, *ba*, *ca*, *bb*, *bc*, *cb*, *cc*.

In like manner four things taken by two's may be varied 4^2 or 16 ways; and five things, by two's, 5^2 or 25 ways.

Thus also when taken by three's the changes will be n^3 and when taken by four's, they will be n^4 and so generally when taken by n's they will be n_n, wherefore adding all those together, the whole number of changes or combinations in n things taken by two's, by three's, by fours, &c. to n's, will be the sum of the geometrical series, $n+1^2+n^3+n^4$, which sum is $=$

$$\frac{n^n-1}{n-1}\times n$$

For example, if the number of things n be four; this gives

$$\frac{4^4-1}{4-1}\times 4=\frac{255}{3}\times 4=340.$$

COMBUSTION. The disengagement of heat and light which accompanies chemical combination. It is frequently made to be synonymous with inflammation, a term which might be restricted, however, to that peculiar species of combustion in which gaseous matter is burned. Ignition is the incandescence of a body, produced by extrinsic means, without change of its chemical constitution.

Although the subject of combustion is incontrovertibly one of the most striking and interesting of chemical phenomena, it is impossible to enter at large on it in this place. We shall therefore simply offer the opinion of Sir H. Davy, as given in Dr. Ure's Chemical Dictionary, which is stated in terms as concise as they are luminous. After adverting to the theories of former writers, which he clearly shews to be incorrect, he adds:—

From the preceding facts, it is evident, 1st, *That combustion is not necessarily dependent on the agency of oxygen*; 2d, That the evolution of the heat is not to be ascribed simply to a gas parting with its latent store of that ethereal fluid, on its fixation or combustion; and, 3dly, That no peculiar substance or form of matter is necessary for producing the effect, but that it is a *general* result of the actions of any substances possessed of strong chemical attractions, or different electrical relations, and that it takes place in all cases in which an intense and violent motion can be conceived to be communicated to the corpuscles of bodies.

All chemical phenomena indeed may be justly ascribed to motions among the ultimate particles of matter, tending to change the constitutions of the mass.

COMET, an opaque, spherical, and solid body, like a planet, performing revolutions about the sun in elliptical orbits, which have the sun in one of the foci. See ASTRONOMY.

COMETARIUM, a curious machine exhibiting an idea of the revolution of a comet about the sun. It is contrived in such a manner, as by elliptical wheels to shew the unequal motion of a comet, in every part of its orbit.

COMETES, a genus of the pentandria monogynia class and order. There is one species, a native of Suratte.

COMMA, among grammarians, a point or character marked thus (,); serving to denote a short stop, and to divide the members of a period.

COMMENSURABLE, among geometricians, an appellation given to such quantities as are measured by one and the same common measure.

COMMENSURABLE *numbers*, whether integers or fractions, are such as can be measured or divided by some other number, without any remainder: such are 12 and 18, as being measured by 6 or 3.

COMMERCE, the exchange of commodities for other articles, or for some representative of value for which other commodities can be procured. See TRADE.

COMMISSARY *general of the musters*, an officer appointed to muster the army, as often as the general thinks proper, in order to know the strength of each regiment and company, to receive and inspect the muster-rolls, and to keep an exact account of the strength of the army.

COMMISSARY *general of stores*, an officer in the artillery, who has the charge of all the stores, for which he is accountable to the office of ordnance.

COMMISSARY *general of provisions*, an officer who has the inspection of the bread and provisions of the army.

COMMITTEE *of Parliament*, a certain number of members appointed by the House for the examination of a bill, making report of an inquiry, process of the House, &c. When a Parliament is called, and the speaker and members have taken the oaths, there are committees appointed to sit on certain days, *viz.* the committee of privileges and elections, of religion, of trade, &c. which are standing committees. Sometimes the whole House resolves itself into a committee, on which occasion each person has a right to speak and reply as often as he pleases, which is not the case when a house is not in a committee.

COMMODORE, in maritime affairs, an officer of the British navy, commissioned by the lords of the admiralty, or by an admiral, to command a squadron of men-of-war in chief.

COMMON, is a right or privilege which one or more persons claim to take or use, in some part or portion of that, which another man's lands, waters, woods, &c. naturally produce; without having an absolute property in such lands, woods, waters, &c. 2 Inst. 65.

COMMON-*place book* is a sort of register, or orderly collection of things worthy to be noted, and retained in the course of a person's reading; and so disposed, as that among a multiplicity of subjects, any one may be easily found.

COMMON-*pleas*, one of the king's courts held in Westminster Hall, wherein a lord chief justice, and three puisne justices preside. In personal and mixed actions, it has a concurrent jurisdiction with the court of king's bench; but has no cognizance of pleas of the crown.

* **COMPANY**, a society of merchants, tradesmen, or others, united in one common interest. When there are only two, three, or four thus associated, it is called a partnership; the word company being usually restrained to a considerable number of members associated by prescription or charter. The mechanics of all towns incorporated are thus formed into companies, which have charters of privileges and immunities. In London they are numerous, and many of them are very rich. In a commercial sense the term company denotes a large association formed for the purpose of trade; thus we have the Hamburgh company which is the oldest trading establishment in the kingdom, being incorporated in 1295; the Russia company confirmed by charter in 1566; the Eastland company settled in 1579; the Turkey or Levant company in 1581, and confirmed with new privileges in 1605; the company of merchants trading to Africa, established in 1750; the South Sea company, formed in the reign of Queen Anne; the East India company, originally established in 1606; and lastly, the Hudson's Bay company, first chartered in 1670.

Company, in the army, a body of foot commanded by a captain, who has under him a lieutenant and an ensign: the number of men is from 50 to 80.

COMPARATIVE *anatomy*, is the science which examines the structure of the body in animals. It includes, in its most extensive sense, a view of the corporeal organization of all classes in the animal kingdom. This science is termed comparative anatomy, not because it stands in contradistinction to human anatomy, but because, while it embraces the whole circle of animal existence, it considers man as the standard of all its comparisons, and the primary object of all its inquiries.

The importance of this science to the anatomical student, and to the student of natural history must be obvious; since it would be absurd to found any system of physiological reasoning on the structure of any single animal or class; while the strongest interest is excited, and the highest degree of satisfaction obtained by this universal survey. We are indebted to such investigations for the discovery of the circulation of the blood, and of the lymphatic system; and there is certainly much truth in the observation of Haller, that "physiology has been more illustrated by comparative anatomy, than by the dissection of the human body." The student who is desirous of entering on this most interesting and instructive subject, will reap much advantage from the perusal of the compendious and scientific view of it published by Blumenbach, and translated into the English language by Dr. Lawrence.

Comparative *degree*, among grammarians; that between the positive and superlative degrees, expressing any particular quality above or beneath the level of another.

COMPARISON *of ideas*, among logicians, that operation of the mind whereby it compares its ideas one with another, in regard of extent, degree, time, place, or any other circumstance, and is the ground of relations.

Comparison, in rhetoric, a figure that illustrates and sets off one thing, by resembling and comparing it with another, to which it bears a manifest relation and resemblance, as the following figure in Shakspeare:

"She never told her love,
But let concealment, like a worm i' the bud,
Feed on her damask cheek: she pined in
thought,
And sat like Patience on a monument,
Smiling at Grief."

COMPARTMENT, or **Compartiment**, in general, is a design composed of several different figures, disposed with symmetry, to adorn a parterre, a ceiling, &c.

COMPASS, or *mariner's compass*, an instrument whereby the ship's course is determined. See Magnetism.

Compasses, or *pair of compasses*, a mathematical instrument for describing circles, measuring figures, &c. They consist of two sharp-pointed branches or legs of iron, steel, brass, or other metal, joined at top by a rivet, whereon they move as on a centre.

COMPLEMENT, in astronomy, the distance of a star from the zenith: or the arch comprehended between the place of the star above the horizon and the zenith.

Complement, in geometry, is what remains of a quadrant of a circle, or of 90°, after any certain arch has been taken away from it. Thus, if the arch taken away be 40°, its complement is 50: because 50+40=90. The sine of the complement of an arch is called the cosine, and that of the tangent, the cotangent, &c.

Complements in a parallelogram, are the two smaller parallelograms made by drawing two right lines through the diagonal, and parallel to the sides of the parallelogram. In every parallelogram, these complements are equal.

COMPLEX *terms*, or ideas, in logic are such as are compounded of several simple ones. Complex ideas, however compounded and recompounded, though their number is infinite, and their variety endless, may be all reduced under these three heads, modes, substances, and relations.

Complex proposition, is either that which has at least one of its terms complex; or such as contains several members, as causal propositions; or it is several ideas offering themselves to our thoughts at once, by which we are led to affirm the same thing of different

objects. Thus, God is infinitely wise, and infinitely powerful.

COMPLEXUS, in anatomy, a broad and pretty long muscle, lying along the back-part and side of the neck.

COMPOSITE ***numbers***, are such as can be measured exactly by a number exceeding unity; as 6 by 2 or 3, or 10 by 5, &c. so that 4 is the lowest composite number. Composite numbers between themselves, are those which have some common measure besides unity; as 12 and 15, as being both measured by 3.

Composite *order*. See Architecture.

COMPOSITION, in grammar, the joining of two words together; or prefixing a particle to another word, to augment, diminish, or change its signification.

Composition, in logic, a method of reasoning, by which we proceed from some general self-evident truth, to other particular and singular ones.

Composition, in music, the art of disposing musical sounds into airs, songs, &c. either in one or more parts, to be sung by a voice, or played on instruments.

Composition, in commerce, a contract between an insolvent debtor and his creditors, by which the latter accept of a part of the debt in compensation for the whole.

Composition, in printing, commonly termed composing, is the arranging of the types, or letters, in the composing-stick, in order to form a line; and of several lines ranged in order in the galley, to make a page; and of several pages to make a form.

Composition of motion, is an assemblage of several directions of motion, resulting from several powers acting in different, though not opposite directions.

Composition of proportion, is the comparing the sum of the antecedent and consequent, with the consequent in two equal ratios; as suppose, 4 : 8 : : 3 : 6, they say, by composition of proportion, 12 : 8 : : 9 : 6. The same holds of the sum of the antecedent and consequent, compared with the antecedent: thus we say 12 : 4 : : 9 : 6. There is a great difference between composition of proportion by addition and by multiplication. See Proportion.

COMPOST, in husbandry and gardening, several sorts of soils, or earthy matters mixed together, in order to make a manure, for assisting the natural earth in vegetation.

COMPOSTO, in music, means compounded or doubled, as a fifteenth is an octave doubled, or an octave is compounded of a fifth and a fourth.

COMPOUND ***flower***, one consisting of several distinct lesser flowers, or corollulæ, each furnished with a style, stamina, &c. The corollulæ are of two kinds, viz. tubulated and ligulated: the tubulated are always furnished with a campanulated limb, divided into four or five segments; whereas the ligulated corollulæ have only a flat, linear limb, terminated by a single point, or by a broader extremity, divided into three or five segments. The plants with compound flowers are extremely numerous, forming a class by themselves, called by Linnæus syngenesia.

COMPRESSION, the act of pressing matter, so as to set its parts nearer to each other, and make it possess less place.

Water was, during a very long period, considered as a fluid perfectly unelastic; that is, unyielding, or incompressible; and this opinion was corroborated by an experiment of the Academy del Cimento in Italy. This opinion prevailed until the year 1761, when Mr. Canton discovered the compressibility of water, and of other liquids, which he immediately made known to the Royal Society. He took a glass tube, having a ball at one end, filled the ball and part of the tube with water, which he had deprived of air as much as it was in his power; then placed the glass thus filled under the receiver of an air-pump; and on exhausting the receiver, which removed the pressure of the atmosphere from the water and the glass vessel which contained it, in consequence of which the water rose a little way into the tube, viz. expanded itself. He then placed the apparatus under the receiver of a condensing engine, and on forcing the air into it, which increased the pressure upon the water, a diminution of bulk evidently took place; the water descending a little way within the tube.

COMPTONIA, a genus of the monœcia triandria class and order. The male cal. is an ament, two-leaved; cor. none; anthers two-parted. The female is also an ament, cal. six-leaved; cor. none; styles two; nect. ovate. There is one species, a shrub of North America.

CONCENTRATION, in chemistry, the act of increasing the strength of fluids, which are rendered stronger by abstracting a portion of the mere menstruum. This is generally effected by evaporation, where the menstruum is driven off at a lower heat than is required to drive off the substance with which it is united. Thus, dilute sulphuric acid may be considered as a mixture of the real acid with water; and by applying a certain heat the water may be evaporized, leaving the acid behind in a state of concentration

CONCENTRIC, in mathematics, something that has the same common centre with another: it stands in opposition to eccentric.

CONCERT, a musical performance in which any number of practical musicians, either vocal or instrumental, or both, unite in the exercise of their respective talents. The concerts of the ancient Greeks were executed only in the unison or octave.

CONCERTO, a composition expressly written for the display of some particular instrument, with accompaniments for the band.

CONCERTATO intimates the piece of music is composed in such a manner, as that all the parts may have their recitativos.

CONCESSION, in rhetoric, a figure, whereby something is freely allowed, that yet might bear dispute, to obtain something that one would have granted.

CONCHA, in anatomy, the larger cavity of the external ear, situated before the meatus auditorius or passage into the internal ear.

CONCHOID, in geometry, the name of a curve, given by its inventor Nicomedes.

This curve was used by Archimedes and other ancients, in the construction of solid problems; and Sir Isaac Newton says that he himself prefers it before other curves, or even the conic sections, in the construction of cubic and biquadratic equations.

CONCORD, in grammar, that part of con

struction, or syntax, in which the words of a sentence agree; that is, in which nouns are put in the same gender, number, and case; and verbs in the same number and person with nouns and pronouns.

Concord, in music, the relation of two sounds that are always agreeable to the ear, whether applied in succession or consonance. See Music.

CONCORDANCE, a sort of dictionary of the Bible, explaining the words thereof in alphabetical order, with the several books, chapters, and verses quoted, in which they are contained.

The best work of this kind which we have in the English language is that of Alexr. Cruden.

CONCRETE, in logic, is used in contradistinction to abstract; for example, when we consider any quality, as whiteness, inhering in any subject, as suppose in snow, if we may say the snow is white, then we speak of whiteness in the concrete; but if we consider whiteness by itself, as a quality that may be in paper, in ivory, and in other things, as well as in snow, we are then said to consider, or to take it in the abstract.

CONCRETIONS, *morbid*, in animal economy, hard substances that occasionally make their appearance in different parts of the body, as well in the solids as in those cavities destined to contain fluids.

CONDENSER, a pneumatic engine or syringe, whereby an uncommon quantity of air may be crowded into a given space; so that sometimes ten atmospheres, or ten times as much air as there is at the same time in the same space, without the engine, may be thrown in by means of it, and its egress prevented by valves properly disposed. See Pneumatics.

CONDITION, in the civil law, a clause of obligation stipulated as an article of a treaty or contract; or in a donation of testament, legacy, &c; in which last case a donee does not lose his donative, if it is charged with any dishonest or impossible conditions.

Condition, in common law, a restraint annexed to a thing, so that by the non-performance the party to it shall sustain loss, and by the performance receive advantage.

CONDITIONAL *syllogism*, a syllogism where the major is a conditional proposition. Thus,

If there is a God, he ought to be worshipped.
But there is a God;
Therefore he ought to be worshipped.

CONDUCTOR, in surgery, an instrument which serves to conduct the knife in the operation of cutting for the stone, and in laying up sinuses and fistulas.

Conductor, in electricity. All bodies are divided into conductors and non-conductors. The latter are called electrics. See Electricity.

CONE, in geometry, a solid figure, having a circle for its base, and its top terminated in a point or vertex. See Conic Sections.

CONFERVA, a genus belonging to the cryptogamia class of plants, and in the natural method ranking under the 57th order, algæ. There are 21 species, most of which grow on stones in slow streams, on the sides of cisterns, or in ponds.

CONGELATION, may be defined the transition of a liquid into a solid state, in consequence of an abstraction of heat: thus metals, oil, water, &c. are said to congeal when they pass from a fluid into a solid state. With regard to fluids, congelation and freezing meaning the same thing. Water congeals at 32°, and there are few liquids that will not congeal, if the temperature be brought sufficiently low. The only difficulty is to obtain a temperature equal to the effect; hence it has been inferred that fluidity is the consequence of caloric. Every particular kind of substance requires a different degree of temperature for its congelation, which affords an obvious reason why particular substances remain always fluid, while others remain always solid, in the common temperature of the atmosphere, and why others are sometimes fluid, and at others solid, according to the vicissitudes of the seasons, and the variety of climates.

Under the article Freezing, will be given a short table of freezing mixtures, the remaining part of this article shall be devoted to the new and elegant mode of congelation by the air-pump, originally, we believe, invented by Mr. Nairn, but brought to its present state of perfection by Professor Leslie of Edinburgh.

Accounts of this most beautiful experiment have been published in different philosophical works, but many of them are stated in such a form as is rather calculated to mar the efforts of the experimentalist, than to insure his success.

The following directions are offered as the result of a repetition of the process more than a hundred times, under almost every variety of form in which it could be effected.

Place on the plate of the air-pump a flat circular vessel of glass, of such a diameter as the size of the plate will admit, and of about an inch in depth. Pour into this vessel as much of the best sulphuric acid that can be obtained as will fill it to rather better than the depth of half an inch, place in the centre of the dish, containing the acid, a small metallic ring supported by three glass legs; and in this ring place a cup of *porous earthen ware*, containing the water to be frozen. Cover the whole with a low receiver, and push the exhaustion as far as the nature of the circumstances will admit.

During the process of exhaustion there will be perceived, in the water, the appearance of a delicate effervescence; in about five or six minutes after it is completed, there will appear a slight degree of roughness about the edge of the water; and in from five, to ten minutes more, the congelation will be seen to sweep over the whole surface of the water, obscuring it like a cloud. The congelation will now proceed rapidly; and in the space of an hour the mass will become solid, and may be removed from the cup. It may be necessary here to observe that the above statement has reference to the process as conducted on the common air-pump: when the large and powerful apparatus used by Mr. Leslie is employed, the effect will be produced in a shorter time, and on a greater quantity of water. From the Professor's own account of this experiment it would appear that, instead of a porous earthen ware cup, he sometimes used a glass one. He has not stated what the effect of this difference was; perhaps with his superior pump it might

be inconsiderable, but the case is far otherwise when the experiment is made on a small scale, as the following facts incontestibly prove. About a *table spoonful* of water was exposed in a glass cup to the action of a surface of acid of eight inches in diameter, and three quarters of an inch in depth; the receiver was exhausted, and the whole suffered to remain in this state for an hour, and in some instances, for two hours, but not the smallest symptom of freezing appeared, although a considerable evaporation took place. It was then removed, and four times the quantity of water, of the same temperature, put in a *porous cup*, was placed under the receiver, and over the same acid; before the exhaustion was completed, numerous star-like particles appeared on the surface of the water; and in exactly four minutes and a half, after it was completed, feathered spiculæ of ice shot across in every direction. At this instant the cup was removed, and although there appeared no ice at the bottom, yet on pouring out the water, a beautiful sheet of ice, perfectly transparent, and resembling a watch glass, was found adhering firmly to the cup, but which was easily separated by the application of a slight degree of warmth.

Instead of using sulphuric acid as an absorbent in this process, parched oatmeal, dry porphyritic trap, and pipe-clay have been recommended, but neither of these is so effectual as the acid, as any one will soon find who chooses to make the trial. Fig 5. Plate X. exhibits a section of the requisite apparatus for performing artificial congelation. AA, is the plate of the air-pump; B the glass bason containing the sulphuric acid; C the cup of porous earthen ware, containing the water to be frozen, and placed in its stand; and D the hemispherical glass receiver.

CONIC *sections* are curve lines formed by the mutual intersection of a plane, and the surface of a solid. The nature and properties of these figures formed a most extensive branch of the ancient geometry, and in modern times the greater part of the discoveries of the last century must appear absolutely unintellegible without a tolerable knowledge of conic geometry. These sections are derived from the different directions in which the solid cone is cut, by a plane passing through it; and they are, a triangle, a circle, an ellipse, a parabola, and an hyperbola. The mode of obtaining these sections is as follows.

If a cone be cut by a plane through the vertex, the section will be a triangle, ABC fig. 1. If the cone be cut by a plane parallel to the base, the section will be a circle. If by a plane DEF in such a direction that the side AC of a triangle passing through the vertex and its base perpendicular to EF may be parallel to DP the section is a parabola; if by a plane (DR fig. 2) meeting AC, the section is an ellipse; if by a plane DMO, fig. 3, meeting AC extended beyond A, it is an hyperbola.

If a line HG, fig. 1. be drawn in a parabola perpendicular to DP the square of HG will be to that of FP as DG to DP; for let LHK be a section parallel to the base, and consequently a circle, the rectangle LGK will be equal to the square of HG, and the rectangle BPC=the square of EP; ∴ these squares will be to each other as their rectangles.

There are three ways of investigating the properties of these curves. 1. By taking the demonstrations from the sections of a cone. 2. By taking a general property of the figures on a plane from which the others may be determined geometrically, or by taking the general property of each curve, and from it deducing all the other properties of the same curve. 3. By taking the equation to all the curves from whence their respective properties may be had by algebra, or by taking the equation to each singly, from whence its properties may be found by the same means.

Hereby the general property of conic sections is discovered, which makes the basis of the other methods. If they are considered as curves on a plane, they have the same properties as those formed by the intersections of a plane with a cone: and again the equation is produced which forms the basis of an algebraical process. Boscovich has deduced the properties of the three curves from one common property, and his method has been simplified by Mr. Newton of Cambridge. The foundation of his method is the mutual relation of two lines, one drawn from a given point, the other perpendicular to a line in a given position. I. If a point S be assumed without the line DX, fig. 4, and 5. and while the line SP revolves about S as a centre, a point P moves in it, so that its distance from S shall always be to PE, its distance from the line DX in a given ratio; the curve described by the point P is called a conic section, a parabola, an ellipse, or a hyperbola, as SP is equal to, less or greater than PE. II. The indefinite right line DX, is named the directrix. III. The point S is the focus. IV. The ratio of SP to PE is the determining ratio. V. If a line SD be drawn through the focus perpendicular to the directris, it is called the axis of the conic section. VI. The point A is the vertex. VII. A right line LST drawn through the focus parallel to the directrix and terminated by the curve in the points L, T is the principal parameter, or the latus rectum. *Corollaries.* (1.) SP being greater than PE, in the hyperbola, two curves will be described, which are called opposite hyperbolas. (2.) When the line SP comes into the position SAD; SP, PE, will be equal to SA, AD; ∴SA is to AD in the determining ratio. (3.) When SP comes into the position SL or ST, the distance of P from the directrix will be equal to SP and SL, or ST will be to SD in the determining ratio; ∴ the latus rectum LT is bisected in S. (4.) The latus rectum in the parabola is equal to double the distance of the locus from the directrix or to four times that from the vertex · for SL=SD, and SA=AD, ∴ LT=twice SD, or four times SA. VIII. The tangents DLQ, DTQ, fig. 6. and 7, which are drawn through the extremities of the latus rectum are called focal tangents. IX. The line AM in the ellipse and hyperbola, is termed the transverse axis, or major axis. X. If the transverse axis is bisected in C, the point C is called the centre of the ellipse or hyperbola. XI. If a line BC*b* bisected in C, be drawn perpendicularly to the transverse axis, and CB, C*b* be each a mean proportional between SA, SM, the segments of the axis intercepted between the focus and the vertices BC*b* is called the conjugate axis, or axis minor. XII. A right line PN*p* drawn through any point N in the axis parallel to the

tangent KAG, or perpendicular to the axis, and terminated by the curve in the points P and p is called an ordinate to the axis. XIII. And the segment of this axis AN intercepted between the ordinate and vertex in all the sections, also the other segment NM in the ellipse and hyperbola, is termed an abscissa. XIV. A line passing through the centre of an ellipse or hyperbola, which is terminated both ways by the curve in the former, and by the opposite curves in the latter, is called a diameter. XV. A line drawn through a point in the parabola parallel to the axis is a diameter to the parabola. XVI. The point where a diameter meets the curve, is a vertex to that diameter. XVII. If from the centre C, at the distance CA, (fig. 8.) half the transverse axis, a circle be described, cutting the directrix of the hyperbola in the points Hh, and lines be drawn from the centre through the points of intersection, they are called asymptotes. XVIII. If AM be the transverse axis, and Bb the conjugate axis of two opposite hyperbolas, and two other hyperbolas be described, the transverse axis, of which is Bb, and the conjugate AM, these last hyperbolas are conjugate to the former. XIX. If the two axes are equal, the hyperbolas are equilateral. XX. A right line drawn through any point in the diameter of a conic section, parallel to the tangent at its vertex, terminated both ways by the curve, is called an ordinate to that diameter. XXI. A diameter parallel to the tangent at the vertex of any diameter of the ellipse or hyperbola, is termed a conjugate diameter. XXII. A line which is a third proportional to any diameter of the ellipse or hyperbola and its conjugates is called a parameter to that diameter. XXIII. A line drawn through the focus of a parabola parallel to the ordinates of any diameter which is terminated both ways by the curve, is called a parameter to the diameter.

From these fundamental properties all the others are derived, and the curves may be mechanically described. This description depends, for the *parabola*, on the property that a line from a point in the curve to the focus, is equal to one drawn from the same point perpendicularly on the directrix; for the *ellipse*, on the property that the sum of the lines from the foci to a point is equal to the major axis; for the *hyperbola*, that the difference of the lines from the foci to a point in the curve is equal to the major axis.

Description of Conic sections on a plane.

1. *Parabola.* Let AB, (fig. 9.) be a right line and C a point without it, and DKF a ruler in the same plane, with the line and point so that one side as DK, be applied to AB, and KF, coincide with the point C and at F, fix one end of the thread at FNC, and the other at the point C; and let part of the thread, as FN, be brought to the side KF by a pin N; then let the square DKF, be removed from B to A, applying its side DK close to BA; and in the mean time the thread will be always applied to the side KF; and by the motion of the pin N will be described a curve called a semi-parabola. Then, bringing the square to its first position, moving from B to H the other semi-parabola will be described.

2. *Ellipse.* If two points as A and B, (fig. 10.) be taken in any plane, and in them is fixed a thread longer than the distance between them, and this extended by means of a pin C; and the pin be moved round from any point till it return back again to the same place, the thread being extended all the while, the figure described is an ellipse.

3. *Hyperbola.* If to the point A (fig. 11.) one end of the ruler AB be placed so that about that point as a centre it may freely move; and if to the other end B is fixed the extremity of the thread BDC, shorter than the ruler AB, and the other end of the thread fixed in the point C, coinciding with the side of the ruler AB in the same place with the given point A; let part of the thread BD be brought to the side of the ruler AB by the pin D; then let the ruler be moved about the point A, from C to T, the thread extended, and the remaining part coinciding with the side of the ruler; by the motion of the pin D a semi-hyperbola will be described. The ellipse returns into itself. but the parabola and hyperbola are unlimited.

If a line GM (fig. 9.) be drawn from a point in a parabola perpendicular to the axis, it will be an ordinate to the axis, and its square will be equal to the rectangle under the abcissa MI and latus rectum; for because GMC is a right angle, GM^2 is equal to the difference of GC^2 and CM^2; but GC is equal to GE, which is equal to MB; therefore GM^2 is equal to $BM^2—CM^2$; which, because CI and IB are equal, is (8 Euc. 2.) equal to four times the rectangle MI and IB, or equal to the rectangle under MI and the latus rectum.

From the genesis of the sections may be seen how one section degenerates into another. For an ellipsis being that plane of any section of the cone between the circle and parabola, it is easy to perceive that there may be a great variety of ellipses produced from the same cone; and when the section is parallel to one side of the cone, then the ellipsis becomes a parabola. This again being that section whose plane is always parallel to the side of the cone cannot vary as the ellipsis may; for when it moves from its parallel position, it degenerates into an ellipsis or hyperbola, therefore a circle may change into an ellipsis, the ellipsis into a parabola, the parabola into an hyperbola, and this again into an isosceles triangle.

Of Equations of Conic Sections.

The equation of a curve is an algebraic expression, denoting the relation between the ordinate and abscissa: the latter equal to x, and the former to y.

Let p be the parameter of a parabola, then $y^2=px$; the equation for all parabolas. Let a be the diameter of an ellipse and p, the parameter; then $y^2=\frac{p}{a}—\overline{ax+x^2}$ the equation for all ellipses.

Let a be the transverse diameter of an hyperbola, and p its parameter; then $y^2=\frac{a}{p}\times\overline{ax+x^2}$. If a be the second diameter then $y^2=\frac{p}{n}\times\overline{a^2+x^2}$, these are the equations for hyperbolas. As all equations are expressed by the second powers of x and y, all conic sections are curves of the second order: and again the locus of every quadratic equation is a conic section, therefore is a parabola, an ellipse, or hyperbola, as the form of the equation agrees with the above, or with any other, de-

duced from lines drawn in a different way with regard to the section.

Properties peculiar to the hyperbola.—As the hyperbola has some curious properties arising from its asymptotes which appear at first view almost incredible, we shall briefly demonstrate them.

(1) The hyperbola and its asymptotes never meet: if not, let them meet in S (fig. 11;) then by the property of the curve the rectangle $KX \times XE$ is to SX^2 as GE^2 to GM^2 or EP^2; that is, as GX^2 to SX^2; wherefore $KX \times XE$ will be equal to the square of GX; but the rectangle $KX \times XE$, together with the square of GE, is also equal to the square of GX; which is absurd.

(2) If a line be drawn through an hyperbola parallel to its second axis, the rectangle, by the segments of that line, betwixt the point in the hyperbola and the asymptotes, will be equal to the square of the second axis.

For if SZ (fig. 11.) be drawn perpendicular to the second axis, by the property of the curve, the square of MG, that is, the square of PE, is to the square of GE, as the squares ZG and the square of MG together, to the square of SZ or GX; and the squares of RX and GX are in the same proportion, because the triangles RXG, PEG; are equiangular; therefore the squares ZG and MG are equal to the square of RX; from which, taking the equal squares of SX and ZG, there remains the rectangle RSV, equal to the square of MG.

(3) Hence, if right lines be drawn parallel to the second axis, cutting an hyperbola and its asymptotes, the rectangles contained betwixt the hyperbola and points where the lines cut the asymptotes will be equal to each other; for they are severally equal to the square of the second axis.

(4) If from any points, d and S, in an hyperbola, there be drawn lines parallel to the asymptotes $d\,a$ SQ and S $b\,d\,c$, the rectangle under $d\,a$ and $d\,c$ will be equal to the rectangle under QS and S b; also the parallelograms $d\,a$ G c, and SQG b, which are equiangular, and consequently proportional to the rectangles, are equal.

For draw YW RV parallel to the second axis, the rectangle $Y\,d \times d\,W$ is equal to the rectangle $RS \times SW$; wherefore WD is to SV as RS is to d Y. But because the triangles RQS, a YD, and GSV, $c\,d$ W, are equiangular, W d is to SV as $c\,d$ to S b, and RS is to DY as SQ to $d\,a$; wherefore, $d c$ is to S b as SQ to $d\,a$; and the rectangle $d\,c$, $d\,a$, is equal to the rectangle QS, S b.

(5) The asymptotes always approach nearer the hyperbola.

For, because the rectangle under SQ and S b or QG, is equal to the rectangle under $d\,a$ and $d\,c$, or AC and QG is greater than a G; therefore, $d\,a$ is greater than QS.

(6) The asymptotes come nearer the hyperbola than any assignable distance.

Let X be any small line. Take any point, as d, in the hyperbola, and draw $d\,a$, $d\,c$ parallel to the asymptotes: and as X is to $d\,a$, so let a G be to GQ. Draw QS parallel to $a\,d$, meeting the hyperbola in S; then QS will be equal to X. For the rectangle $SQ \times QG$ will be equal to the rectangle $d\,a \times a\,G$; and consequently SQ is to $d\,a$ as AG to GQ.

If any point be taken in the asymptote below Q, it can easily be shown that its distance is less than the line X.

General properties of conic sections.—A tangent to a parabola bisects the angle contained by the lines drawn to the focus, and directrix; in an ellipse and hyperbola, it bisects the angle contained by the lines drawn to the foci. In all sections, lines parallel to the tangent are ordinates to the diameter passing through the point of contact, and in the ellipse and hyperbola, the diameters parallel to the tagent, and those passing the points of contact, are conjugate to each other. If an ordinate be drawn from a point to a diameter, and a tangent from the same point which meets the diameter produced in the parabola, the part of the diameter between the ordinate and tangent will be bisected in the vertex; and in the ellipse and hyperbola, the semi-diameter will be a mean proportional between the segments of the diameter, the centre and ordinate, and the centre and tangent. The parallelograms, formed by tangents drawn through the vertices of any conjugate diameter, in the same ellipses or hyperbola, will be equal to each other.

CONJUGATE *diameter*, or axis of an ellipsis, the shortest of the two diameters, or that bisecting the transverse axis.

CONJUGATE *hyperbolas.* See CONIC SECTIONS.

CONJUGATION, in grammar, a regular distribution of the several inflections of verbs in their different voices, moods, tenses, numbers, and persons, so as to distinguish them from one another.

The English have scarcely any natural inflexions, deriving all their variations from additional particles, pronouns, &c. whence there is scarcely any such thing as strict conjugation in that language.

CONIUM, *hemlock*, a genus of the digynia order, in the pentandria class of plants, and in the natural method ranking under the 45th order, umbellatæ. There are five species; the most remarkable are,

1. Conium Africanum, with prickly seeds, a native of the Cape of Good Hope, and rarely growing above nine inches high: the leaves are of a greyish colour, and the flowers are white.

2. Conium maculatum, or the greater hemlock, grows naturally on the sides of banks and roads in many parts of Britain. It is a biennial plant, which perishes after it has ripened its seeds. The stalk is smooth, spotted with purple; and rises from four to upwards of six feet high, branching out towards the top, with decompounded leaves. The stalks are terminated by umbels of white flowers. This species is poisonous when taken in large quantities, yet it is found very efficacious in some diseases.

3. Conium tenuifolium, with striated seeds. This is also a biennial plant, and much resembles the preceding. It is a native of Germany.

CONJUNCTION. See ASTRONOMY.

CONNARUS, *Ceylon Sumach*, a genus of the decandria order, in the monadelphia class of plants, ranking under the dubious in the natural method. Of the four species, the most remarkable is the connarus monocarpus, a native of India, which grows to the height of eight or ten feet, and the stalk is covered with a thick black bark.

CONOID, in geometry, a solid body, generated by the revolution of a conic section about its axis.

CONOPS, a genus of insects of the order of diptera, of which there are 13 species. 1. The Calcitrans, is to be found every where, especially in autumn, when it is a great torment to horses. 2. The macrocephala, resembles a wasp, but is variegated with yellow, black, red, and brown. The other species are not remarkable.

CONSANGUINITY, or kindred, is the connection or relation of persons descended from the same stock or common ancestor; and is either lineal or collateral. Lineal consanguinity is that which subsists between persons, of whom one is descended in a direct line from the other; as grandfather, father, and son. Collateral consanguinity is that which subsists between persons descended from the same common ancestor, but not from one another; as brothers, uncles, and nephews.

Consanguinity terminates in the sixth and seventh degree, excepting in the succession of the crown, in which case it is continued to infinity.

CONSCIENCE, in ethics, a secret testimony of the soul, whereby it gives its approbation to things that are naturally good, and condemns those that are evil.

CONSEQUENT *of a ratio*, in mathematics, the latter of the two terms of a ratio, or that to which the antecedent is compared; thus in $m : n$, or m to n, n is the consequent, and m the antecedent.

CONSIGNMENT, the sending, or delivering over, goods, money, or other property, to another person. It may be either consigned unconditionally, or for some particular purpose. Consigned goods are supposed in general to be the property of him *by* whom they are consigned, but to be at the disposal of him *to* whom they are consigned.

CONSONANCE, in music, is the effect of two or more sounds heard at the same time; but its general signification is confined to concording intervals.

CONSONANT, a letter that cannot be sounded without some single or double vowel before or after it. Consonants are first divided into single and double; the double are *x* and *z*, the rest are all single: and these are again divided into mutes and liquids; eleven mutes, *b, c, d, f, r, g, j, k, p, q, t*; and four liquids, *l, m, n, r*. But the most natural division of consonants is that of the Hebrew grammarians, who have been imitated by the grammarians of other oriental languages.

CONSPIRACY, in law, signifies an agreement between two or more, falsely to indict, or procure to be indicted, an innocent person for felony.

CONSTELLATION, in astronomy, a system of several stars that are seen in the heavens near to one another. See ASTRONOMY.

CONSTITUTION, in matters of policy, signifies the form of government established in any country or kingdom.

The constitution and government of a country frequently differ, though the latter should be founded on the former in every particular.

CONSTITUTION also denotes an ordinance, decision, regulation, or law, made by authority of any superior, ecclesiastical or civil. The constitutions of the Roman emperors make a part of the civil law, and the constitutions of the church make a part of the canon law.

CONSTRUCTION, in geometry, is the drawing such lines, such a figure, &c. as are previously necessary for the making any demonstration appear more plain and undeniable.

CONSTRUCTION *of equations*, in algebra, the method of drawing a geometrical figure whose properties shall express the given equation, in order to demonstrate the truth of it geometrically.

CONSUL, is an officer established by virtue of a commission from the King, and other princes, in all foreign countries of any considerable trade, to facilitate and despatch business, and protect the merchants of the nation.

CONSUMPTION, in medicine, a word of very extensive signification, implies all disorders that bring any decay or waste upon the constitution.

CONTACT, is when one line, plane, or body, is made to touch another, and the parts that do thus touch are called the points or places of contact.

CONTENT, in geometry, the area or quantity of matter or space included in certain bounds.

CONTIGUOUS *angles*, in geometry, are such as have one leg common to each angle; and are sometimes called adjoining angles, in contradistinction to those produced by continuing their legs through the point of contact, which are called opposite or vertical angles.

CONTINENT, in geography, a great extent of land not interrupted by seas, in contradistinction to island, peninsula, &c.

CONTINGENT, something casual or uncertain. Hence future contingent, in logic, denotes a conditional event which may or may not happen, according as circumstances fall out.

CONTINGENT is also a term of relation for the quota that falls to any person upon a division. Thus each prince in Germany, in time of war, was formerly obliged to furnish so many men, so much money and ammunition for his contingent.

CONTINGENT *use*, in law, is a use limited in a conveyance of lands which may or may not happen to vest, according to the contingency mentioned in the limitation of the use.

CONTINUED *proportion*, in arithmetic, is that where the consequent of the first ratio is the same with the antecedent of the second; as $4 : 8 :: 8 : 16$, in contradistinction to discrete proportion.

CONTOUR, the outline of a figure. It is sometimes used with great latitude, to express the general cast or lineaments of the visage See PAINTING.

CONTRABAND, in commerce, a prohibited commodity or merchandize bought or sold, imported or exported, in prejudice to the laws and ordinances of a state, or the public prohibitions of the sovereign.

CONTRACT, a covenant or agreement between two or more persons, with a lawful consideration or cause. Contracts are either express or implied. Express contracts are, where the terms of the agreement are openly

uttered, as to pay a stated price for certain goods. Implied, are such as reason and justice dictate, and which therefore the law presumes that every man undertakes to perform.

CONTRA-*harmonical proportion*, in arithmetic, is that relation of three terms, wherein the difference of the first and second is to the difference of the second and third as the third is to the first: thus, 3, 5, and 6, are numbers contra-harmonically proportional, for 2 : 1 : : 6 : 3.

CONTRAST, the artificial opposition in works of painting and sculpture, of groups, attitudes, or colours; so as by their variety and striking difference, to strengthen the effect of the whole.

CONTRATE-*wheel*, in watch-work, that next to the crown, the teeth and hoop of which lie contrary to those of the other wheels, whence it takes its name.

CONTRAVALLATION, in the military art, implies a line formed in the same manner as the line of circumvallation, to defend the besiegers against the enterprises of the garrison; so that the army forming a siege lies between the lines of circumvallation and contravallation.

CONTRAYERVA, in the materia medica, the name by which the root of the dorstenia plant is known in the shops.

CONTRE, in heraldry, an appellation given to several bearings, on account of their cutting the shield contrary and opposite ways.

CONTROLLER, an officer appointed to control or oversee the accounts of other officers, and, on occasion, to certify whether or no things have been controlled or examined. In England we have several officers of this name, controller of the King's house, controller of the navy, controller of the customs, controller of the mint, &c.

CONTUMACY, in law, a refusal to appear in court, when legally summoned; or the disobedience to the rules and orders of a court, having power to punish such offence.

CONVALLARIA, or *lily of the valley*, a genus of the monogynia order, in the hexandria class of plants, and in the natural method ranking under sarmentaceæ, or 11th order. The species are 11, two of which are natives of Britain, viz. the maialis, or May lily; and the multiflora, or Solomon's seal. They are plants of considerable beauty, and may be propagated by their creeping roots.

CONVENTION, a treaty, contract, or agreement between two or more parties. Every convention among men, provided it be not contrary to honesty and good manners, produces a natural obligation, and makes the performance a point of conscience.

CONVENTICLE, a diminutive of *convent*; denoting properly a cabal, or secret assembly, of a part of the monks of a convent, to make a brigue or party in the election of an abbot. From the ill use of these assemblies the word is come into disrepute; and now stands for any mischievous, seditious, or irregular assembly. The term conventicle is said, by some, to have been first applied in England to the schools of Wickliffe; and has been since used to signify the religious assemblies of all in this country who do not conform to the established doctrines and worship of the church of England.

CONVERGING or *convergent lines*, in geometry, are such as continually approach nearer one another, or whose distance becomes still less and less.

CONVERGING *hyperbola*, is one whose concave legs bend in towards one another, and run both the same way.

CONVERGING *rays*, in optics, those rays that, issuing from divers points of an object, incline towards another, till they meet and cross, they then become diverging rays. See OPTICS.

CONVERSE, in mathematics. One proposition is called the converse of another, when, after a conclusion is drawn from something supposed in the converse proposition, that conclusion is supposed; and then, that which in the other was supposed, is now drawn as a conclusion from it.

CONVERSION *of equations*, in algebra, is when the quantity sought, or any part or degree of it, being in fractions, the whole is reduced to one common denomination, and then omitting the denominators, the equation is continued in the numerators only.

CONVERSION *of propositions*, in logic, the changing of the subject into the place of the predicate, and the predicate into the place of the subject; and yet always retaining the same quality of both propositions.

CONVEX, an appellation given to the exterior surface of gibbous or globular bodies, in opposition to the hollow inner surface of such bodies, which is called concave.

CONVEYANCE, in law, a deed which passes land from one to another. The most common conveyances now in use are, deeds of gift, bargain and sale, lease and release, fines and recoveries, settlements to uses, &c.

CONVOLVULUS, in botany, a genus of the pentandria monogynia class and order. Natural order of campanaceæ, or bell-form flowers. Essential character: corolla bell-shaped, plaited; stigmas two; capsules two-celled, with two seeds in each cell. There are 110 species of this very numerous genus, not more than thirteen species are natives of Europe; the others are mostly inhabitants of the warmer climates of Asia and America. Very few of them are cultivated in our gardens, except C. purpureus, purple bindweed; and C. tricolor, trailing bindweed, more commonly known by the names of convolvulus, major and minor; the stems are herbaceous and milky, in the greater part twining, in a very few shrubby; leaves alternate; peduncles axillary or terminating, one flowered, with two bractes, or many flowered

CONVOY, in marine affairs, one or more ships of war, employed to accompany and protect merchants' ships, and prevent their being insulted by pirates or the enemies of the state in time of war.

CONVOY, in military affairs, a detachment of troops employed to guard any supply of men, money, ammunition, provisions, stores, &c. conveyed in time of war, by land or sea, to a town or army.

CONVULSION, *spasmus*. See MEDICINE.

CONYZA, *fleabane*, a genus of the polygamia superflua order, in the syngenesia class of plants, and in the natural method ranking under the 49th order, compositæ. There are 41 species, none of which merit any particular description.

COOPER, one who manufactures casks, tubs of all sizes, pails, and some other similar articles used in domestic concerns. These are made generally of oak timber; a great part of which comes from America, cut up into narrow pieces or staves; they are sometimes bent, and sometimes straight, according to the purposes for which they are wanted. The staves are kept together by means of hoops, made from hazel or ash, or of iron.

COPAIFERA, a genus of the monogynia order, in the decandria class of plants, and in the natural method ranking under those of which the order is doubtful. There is but one species, the officinalis, which yields the copaiba balsam. This tree grows in the province of Antiochi, in the Spanish West Indies. Some of these trees do not yield any balsam; those which do are distinguished by a ridge which runs along their trunks. These trees are wounded in the centre; and one of them will yield five or six gallons of balsam.

COPAL, improperly called *gum copal*, is a hard, shining, transparent, citron-coloured, odoriferous, concrete juice of an American tree, but which has neither the solubility in water common to gums, nor the solubility in alcohol common to resins, at least in any considerable degree. By these properties it resembles amber. It may be dissolved by digestion in linseed oil, rendered drying by quick-lime, with a heat very little less than sufficient to boil or decompose the oil. This solution, diluted with oil of turpentine, forms a beautiful transparent varnish, which, when properly applied, and slowly dried, is very hard, and very durable. This varnish is applied to snuff-boxes, tea-boards, and other utensils. It preserves and gives lustre to paintings, and greatly restores the decayed colours of old pictures, by filling up the cracks, and rendering the surfaces capable of reflecting light more uniformly.

COPPER, a metal next to iron in specific gravity, but lighter than gold, silver, or lead.

This metal is of a fine red colour, and has a great deal of brilliancy. Its taste is styptic and nauseous; and the hands when rubbed for some time on it, acquire a peculiar and disagreeable odour. Its malleability is great it may be hammered out into leaves so thin as to be blown about by the slightest breeze. Its ductility is also considerable. Its tenacity is such, that a copper wire 0.078 inch in diameter is capable of supporting 302.26 pounds avoirdupoise without breaking. See CHEMISTRY.

COPPERAS is the sulphate of iron, and is commonly called green vitriol. If sulphuric acid be diluted with water, and be poured upon iron, much effervescence will be seen: the metal will be dissolved, and the solution, when evaporated, will exhibit the sulphate of iron, or common copperas, which is a neutral salt in a very impure state.

COPULA, in logic, the verb that connects any two terms in an affirmative or negative: as, "Riches make a man happy;" where *make* is the copula.

COPULATIVE *propositions*, in logic, those where the subject and predicate are so linked together by copulative conjunctions, that they may be all severally affirmed or denied one of another

COPY, in a legal sense, is the transcript of an original writing: as the copy of a patent, of a charter, deed, &c.

COPY, among printers, denotes the manuscript, or original of a book, given to be printed.

COPYHOLD, in the law of England, is a species of land tenure, evidently the offspring of the ancient tenure in villenage. It is called *copy-hold* because the tenant holds his lands by copy of court roll of the manor at the will of the lord.

COPYING *machine*. See POLYGRAPH.

COPY-*right*. See LITERARY PROPERTY.

COR *Caroli*, in astronomy, an extra-constellated star in the northern [illegible]misphere, situated between the Coma Berenices, and Ursa Major, so called by Dr. Halley in honour of King Charles,

COR *Hydræ*, a fixed star of the first magnitude, in the constellation of Hydra.

COR *Leonis*, or *Regulus*, in astronomy, a fixed star of the first magnitude, in the constellation Leo.

CORACIAS, the roller, a genus of birds of the order of picæ. Sixteen species have been enumerated, though some of them are suspected to be only varieties. The following are the most remarkable:

1. The garrula, or garrulous roller, is about the size of a jay: the bill black, and at the base beset with bristles; the head, neck, breast, and belly, are of a light-bluish green; back and scapulars, reddish brown; coverts on the ridge of the wing, a rich blue, beneath a pale green; upper part and tips of the quills dusky; the lower parts of a fine deep blue, tail forked, of a light blue; the legs are short and of a dirty yellow. Mr. Pennant observes that these birds are frequent in several parts of Europe. The flesh tastes like that of a turtle.

2. The cyanea, or blue-striped roller is eight inches long; the bill three quarters of an inch long, bent at the tip, and of a black colour; the general colour of the plumage deep blue-black, dashed with streaks of greenish blue; the tail and legs are black; it inhabits New Caledonia.

3. The sinensis, or Chinese roller is of the size of a jay, the bill and irides are red, but the general plumage is green. It is a native of China, but not very common.

CORAL *fishery*. Red coral is found in the Mediterranean, on the shores of Provence, from Cape de la Couronne to that of St. Tropez; about the isles of Majorca and Minorca; on the south of Sicily; on the coast of Africa; and, lastly, in the Ethiopic ocean, about Cape Negro. The divers say, that the little branches are found only in the caverns whose situation is parallel to the earth's surface and open to the south. The manner of fishing being nearly the same wherever coral is found, it will suffice to instance the method used at the bastion of France, under the direction of the company established at Marseilles for that fishery Seven or eight men go in a boat commanded by the patron or proprietor, and when the net is thrown by the caster, the rest work the vessel, and help to draw the net in. The net is composed of two rafters of wood tied crosswise, with leads fixed to them: to these they fasten a quantity of hemp twisted loosely round, and intermingled with some large net-

ting. This instrument is let down where they think there is coral, and pulled up again when the coral is strongly entangled in the hemp and netting.

CORALLINA, or *coral*, a genus belonging to the order of vermes zoophyta. The species are distinguished by the form of their branches, and are found in the ocean adhering to stones, bones, shells, &c. The corals were formerly believed to be vegetable substances hardened by the air; but are now known to be composed of a congeries of animals, endued with the faculty of moving spontaneously. The islands in the south-sea are mostly coral rocks covered over with earth. The little creatures, which have scarcely sensation enough to distinguish them from plants, build up a rocky structure from the bottom of that sea, too deep to be measured by human art, till it reaches the surface. Some of the coralline islands appear to be much older than others; and it is probable that, as these submarine works are continually going on, new islands may by that means frequently be produced. M. De Peyssonel of Marseilles, seems to have been the first who threw a proper light upon the nature and productions of coral. Those bodies which the count de Marsigli imagined to be flowers, this ingenious naturalist discovered to be insects inhabiting the coral: for upon taking branches of it out of the water, the flowers, which proceeded from a number of white points, disappeared: but upon being again restored to the water, they again became perceptible. The holes in the bark are the openings through which the insects that form these substances for their habitation come forth: and those cavities which are partly in the bark, and partly in the substance, are the cells which they inhabit. When the insects are dead, they corrupt, and communicate to the water the smell of putrid fish. The milky juice of coral is the blood of the animal, and running along the furrows perceived upon the proper substance or body of coral, becomes fixed, and hard, and is changed into stone.

The coral insect, expands itself in water, and contracts itself in air, or when it is touched with the hand in water, or acid liquors are poured upon it. Broken branches of coral have been observed to fasten themselves to other branches, and have continued to grow; and this is the case when they are connected with detached pieces of rock and other substances, from which no nourishment could be derived.

There are properly but three kinds of coral; red, white, and black; the black is the rarest and most esteemed; but the red was formerly in great repute as a medicine. When coral is newly taken out of the sea, the small protuberances on its surface are soft, and yield, on being pressed, a milky juice which effervesces with acids.

CORALLINES in natural history, were formerly reckoned plants, but in the Linnæan system, are placed in the class zoophytæ, and defined to be submarine plants like bodies, consisting of many slender, finely divided, and jointed branches, or animals, growing in the form of plants, having their stems fixed to other bodies, which stems are composed of capillary tubes, whose extremities pass through a calcareous crust and open into pores on the surface. The branches are often jointed and always subdivided into smaller branches, which are either loose and unconnected, or jointed as if glued together. They are distinguished from plants, by their texture and hardness, they also yield in distillation volatile salt, and their smell, when turbid, resembles that of horns and other animal substances. The corallines are distributed into the vesiculated, tubular, celliferous, and articulated kinds.

CORCHORUS, a genus of the monogynia order, in the polyandria class of plants, and in the natural method ranking under the 37th order, columneæ. There are 16 species; of which the most remarkable is the olitorius, an annual, and a native of Asia, Africa, and America. It rises with a round stalk, to nearly two feet in height. The flowers come out at the sides of the branches opposite to the leaves. They are composed of five small yellow petals, and a great number of stamina. This plant is sold by the Jews about Aleppo, and is therefore called Jews' mallow.

CORDAGE, a term used, in general, for all sorts of cord, whether small, middling, or great, made use of in the rigging of ships.

CORDIA, a genus of the monogynia order, in the pentandria class of plants, and in the natural method ranking under the 41st order, asperifoliæ. There are five species, of which the principal are,

1. The myxa, or Assyrian plum, grows wild in Assyria or Egypt, and also on the coast of Malabar. It rises to the height of a middling plum-tree. The flowers are produced in bunches, and are white. The germen is roundish, and swells to a plum of the same form, and about the size of a damson, of a dark brown colour, a sweet taste, and very glutinous.

2. The sebestena, or rough leaved cordia, is a native of both the Indies, and sends forth several shrubby stalks eight or ten feet high. The plums are much of the shape of those of the myxa. The fruit of this tree is less valuable than the wood, a small piece of which thrown upon a clear fire will perfume a room with a most agreeable odour.

CORDIAL, in medicine, whatever raises the spirits, and gives them a sudden strength and cheerfulness.

CORDON, in fortification, a row of stones, made round on the outside, and set between the wall of the fortress which lies aslope, and the parapet which stands perpendicular.

COREOPSIS, tickseeded sunflower: a genus of the polygamia frustranea order, in the syngenesia class of plants; and in the natural method ranking under the 49th order, compositæ. There are 20 species, most of them herbaceous perennials. They rise from three to eight feet in height; terminated by clusters of compound radiated flowers of a yellow colour. The flowers are all shaped like sunflowers, but smaller, and are very ornamental.

CORIANDRUM, *coriander*, a genus of the digynia order, in the pentandria class of plants, and in the natural method ranking under the 45th order, umbellatæ. There are only two species, both of them herbaceous annuals, the leaves of which are useful for the kitchen, and the seeds are used in medicine. Both species have divided small leaves, resembling parsley: but there is only one species generally culti-

vated, namely, the sativum. This has a small fibrous white root, crowned by many parted leaves, having broadish segments; and in the centre an upright, branchy stalk, two feet high, having all the branches terminated by umbels of flowers, which are succeeded by globular fruit. It is propagated by seed, which ought to be sown in March. The seeds are recommended as carminative and stomachic.

CORIARA, the *tanner's* or *myrtle-leaved sumach*, a genus of the decandria order, in the diœcia class of plants, and in the natural method ranking under the 54th order, miscelaneæ. There are three species, the myrtifolia, rusufolia, and the sarmentosa. The first two are natives of the south of France, but the last is most commonly cultivated in this country.

CORIS, a genus of the monogynia order, in the pentandria class of plants, and in the natural method ranking under the doubtful order. There is only one species, viz. the monspeliensis, or blue maritime coris. There are two varieties of this plant, one with a red, and the other with a white flower; but these are only accidental, and arise from the same seeds. They grow wild about Montpelier, and in most places in the south of France.

CORISPERMUM, *tickseed*, a genus of the digynia order, in the monandria class of plants, and in the natural method ranking under the 12th order, holoraceæ. There are two species; but neither of them is remarkable.

CORK. See QUERCUS.

CORK-FOSSIL, a name given to a kind of stone. It is a species of amianthus, consisting of flexible fibres loosely interwoven, and somewhat resembling vegetable cork. It is the lightest of all stones; it is fusible, and forms a black glass.

CORN, in country affairs, the grain or seeds of plants separated from the spica or ear, and used for making bread.

It is against the common law of England to buy or sell corn in the sheaf, before it is thrashed and measured: the reason whereof seems to be, because by such sale, the market is in effect forestalled.

CORN, in medicine and surgery, a hard tumour like a flat wart, growing in several parts of the feet, especially upon the joints of the toes. This disorder is not unjustly attributed to the wearing of narrow-toed shoes.

CORNEA *tunica*, in anatomy, the second coat of the eye; so called from its substance, which resembles horn.

CORNET, in the military art, signifies a commissioned officer in a troop of horse or dragoons.

CORNUCOPIÆ, a genus of the digynia order, in the triandria class of plants, and in the natural method ranking under the 4th order, gramina. The involucrum is monophyllous, funnel-shaped, crenated, and multiflorous; the calyx bivalved; the corolla one-valved. There are two species.

CORNUS, *cornel-tree*, *cornelian cherry*, or *dogwood*; a genus of the monogynia order, in the tetrandria class of plants, and in the natural method ranking under the 47th order, stellatæ. Of this genus there are 12 species; the most remarkable are the following: 1. The mas or cornelian cherry-tree, has an upright tree stem, rising 20 feet high, and bearing small umbels of yellowish-green flowers, and succeeded by small, red, cherry-like, eatable, acid fruit. 2. The sanguinea, bloody twig, or common dogwood, has an upright stem, branching 10 or 12 feet high, having blood-red shoots, with oblong pointed leaves; all the branches are terminated by umbellate white flowers, succeeded by black berries. 3. The Florida or Virginian dog-wood, rises 12 or 15 feet high. Of this species there are several varieties, chiefly distinguished by the colour of their berries, which are red, white, or blue.

CORNUITA, a genus of the angiospermia order, in the didynamia class of plants, and in the natural method ranking under the 40th order, personatæ. There ar[illegible]wo species: the principal of which is, the p[illegible]midata; it has blue pyramidal flowers and hoary leaves. It grows plentifully in several of the islands of the West Indies. It rises to the height of 10 or 12 feet, with rude branches, the leaves being placed opposite. The flowers are of a fine blue colour.

COROLLA, among botanists, the most conspicuous part of a flower, surrounding the organs of generation. See BOTANY.

COROLLARY, is a consequence drawn from something already advanced or demonstrated.

CORONA, among botanists, expresses any thing growing on the head of a seed.

CORONA *borealis*, the northern crown or garland, in astronomy, a constellation of the northern hemisphere.

CORO[illegible], an ancient officer of the kingdom, and so called because he is wholly employed for the king and crown. In ancient times none under the degree of knight were chosen; but this qualification is now dispensed with. The Lord Chief Justice of the King's Bench is the sovereign coroner of the whole kingdom; but, under him there are two special coroners for each county. The duties of the coroner are, to inquire into the manner of death when any one is slain, or dies suddenly, or in prison. This inquiry must be made, *super visum corporis*, at the very place where the death happened, and in presence of a jury of four, five, or six, or more of the inhabitants of the neighbouring towns. If any person be found guilty of murder by this inquest, the coroner must commit him to prison for trial, and inquire also concerning his lands, goods, and chattels, which are forfeited thereby. It is also the duty of the coroner to inquire concerning shipwrecks, and treasure-trove. Although there are some honourable exceptions, yet it must be allowed that the office of coroner has fallen into great disrepute, since, instead of being filled by men whose circumstances place them beyond the influence of interested motives, it is occupied by characters who have no other view in serving than the emoluments of the office.

CORONILLA, jointed podded colutea, a genus of the decandria order, in the diadelphia class of plants, and in the natural method ranking under the 32d order, papilionaceæ. There are 14 species, all plants of considerable beauty with bright yellow flowers, but the principal is the emerus. This species rises with a shrubby stem, six or eight feet high. The leaves of this plant are esteemed laxative, and used as a substitute for common senna

in some parts of Europe. A dye is procured by fermentation from the leaves, like that of indigo.

CORPORAL, an officer under a serjeant, in a company of foot, who has charge over one of the divisions, places and relieves sentinels, and keeps good order in the corps-de-garde: he also receives the word from the inferior rounds which pass by his corps-de-garde. There are generally three corporals in each company.

CORPORATION, a body politic, or incorporate, so called because the persons or members are joined into one body, and are qualified to take and grant, &c. Corporations are either spiritual or temporal: spiritual, as bishops, deans, archdeacons, parsons, vicars, &c. Temporal, as mayor, commonalty, bailiff, burgesses, &c. And some corporations are of a mixed nature, composed of spiritual and temporal persons, such as heads of colleges and hospitals, &c.

Corporations may be established three different ways, viz. by prescription, letters patent, or act of parliament; but are most commonly established by patent or charter.

A corporation may be dissolved; for it is created upon a trust, and if it be broken, it is forfeited.

CORPUSCULAR *philosophy*, that way of philosophising which endeavours to explain things, and to account for the phenomena of nature by the motion, figure, rest, position, &c. of the corpuscles, or the minute particles of matter.

Boyle reduces the principles of the corpuscular philosophy to the four following heads.

1. That there is but one universal kind of matter, which is an extended, impenetrable, and divisible substance, common to all bodies, and capable of all forms. On this head, Newton remarks thus: "All things considered, it appears probable to me, that God in the beginning created matter in solid, hard, impenetrable, moveable particles; of such sizes and figures, and with such other properties, as most conduced to the end for which he formed them; and that these primitive particles, being solids, are incomparably harder than any of the sensible porous bodies compounded of them; even so hard as never to wear or break in pieces; no other power being able to divide what God made one in the first creation.

2. That this matter, in order to form the vast variety of natural bodies, must have motion in some, or all its parts; and that this motion was given to matter by God, the creator of all things; and has all manner of directions and tendencies. "These corpuscles," says Newton, "have not only a vis inertiæ, accompanied with such passive laws of motion as naturally result from that force; but also are moved by certain active principles; such as that of gravity, and that which causes fermentation, and the cohesion of bodies."

3. That matter must also be actually divided into parts; and each of these primitive particles, fragments, or atoms of matter, must have its proper magnitude, figure, and shape.

4. That these differently sized and shaped particles, have different orders, positions, situations, and postures, from whence all the variety of compound bodies arises.

CORRECTION, in printing, the pointing out or discovering the faults in a printed sheet, in order to be amended by the compositor, before it be printed off. See PRINTERS, *marks of*.

CORRELATIVE, something opposed to another in a certain relation. Thus, father and son are correlatives. Light and darkness, motion and rest, are correlative and opposite terms.

CORROSION, the action of gnawing away, by degrees, the continuity of the parts of bodies. Acids corrode most natural bodies.

CORROSIVES, in surgery, are medicines which corrode whatever part of the body they are applied to; such are burnt alum, white precipitate of mercury, white vitriol, red precipitate of mercury, butter of antimony, and lapis infernalis.

CORTUSA, *bear's ear sanicle*, a genus of the monogynia order, in the pentandria class of plants, ranking in the natural method under the 21st order preciæ. There are two species; both low, flowery, herbaceous perennials, having wheel-shaped flowers of a fine red colour. They are natives of mountainous countries.

CORUNDUM, a mineral, of which there are two species, the perfect and imperfect. Perfect corundum or sapphire is found in the East Indies, especially in Pegu and the island of Ceylon: and it is most commonly crystallized The crystals are of no great size; their primitive form, is a rhomboid whose angles are 86° and 94°.

It causes only a single refraction. Specific gravity, from 3.7 to 4.2. Colour, most frequently blue; sometimes red, purple, yellow, and green, and sometimes colourless; imperfect corundum is usually crystallized; sometimes found in amorphous masses; colour grey, often with various shades of blue and green.

CORUSCATION, a glittering or gleam of light issuing from any thing. It is chiefly used for the electrical fluid when rendered visible, as in a flash of lightning, &c.

CORVUS, the raven or crow kind, in ornithology; a genus of birds of the order of picæ, the distinguishing characteristics of which are these: the beak is convex and cultrated; the nostrils are covered with bristly feathers; the tongue is forked and cartilaginous; and the feet are of the walking kind. According to some naturalists there are 41 species; but Gmelin has enumerated 48. The most remarkable are the following.

1. The corax, or raven of English authors, weighs three pounds, and is about two feet two inches in length; the colour is black, finely glossed with a rich blue, the belly excepted, which is of a dusky colour. They are very docile birds, and may be trained up to fowling like hawks, or to fetch and carry like spaniels; they may be taught to speak like parrots; and even to imitate the human voice in singing. They have a great propensity to pilfer, often hiding things of value, to the great loss of the owner, without use to themselves. Their scent is remarkably good, and they are very long-lived.

2. The corone, or carrion crow, is very similar to the raven in habits and colour, but is only about half its size. It is not so frequently to be met with as the preceding.

3. The frugilegus, or rook, is the corvus of

Virgil; no other species of this kind being gregarious. It differs but little in its form from the carrion-crow: the most remarkable difference is in the nostrils and root of the bill; which parts in the crow are well clothed with feathers, but in the rook are bare or covered only with some bristly hairs. Besides insects, it also feeds on all sorts of grain, and instead of being of inconvenience, it is of service to the husbandman in destroying the maggot of the chafer-beetle, which, in some seasons, destroys whole crops of corn by feeding on the roots. The rook is a gregarious bird, sometimes being seen in immense flocks, so as almost to darken the air.

3. The monedula, or jackdaw. These birds are about the size of a small pigeon, though not quite so thick. They rarely build their nests in trees, preferring the ruins of human habitations, or of churches and towers, where their eggs and young are more beyond the reach of depredating school-boys. They sometimes lay in rabbit holes. They are domesticated with great facility, and may be taught to utter a considerable number of words. They are much addicted to pilfering, hiding not only their food, but a variety of toys and trinkets, a circumstance which has not unfrequently brought suspicion and disgrace upon the most honest domestics.

4. The glandarius, or jay. The jay weighs about seven ounces, and is about thirteen inches long. Its colours are beautifully arranged, by which it attracts attention, but its voice is harsh and chattering. Its nest is built of sticks, roots, and tender twigs, in the woods. Jays feed on almost all sorts of seeds and fruits, on nuts and acorns, and occasionally on eggs and even chickens. They will imitate with great ease and accuracy a variety of sounds, and articulate a considerable number of words, and, by this acquired talent, have sometimes produced considerable mischief. The jay is not found in the south, beyond Greece or Italy, and is unknown in Ireland.

5. The pica, or magpie. This bird is extremely common in England, and is found in most countries between Sweden and Italy in Europe. In America it is rare, and is a bird of passage. Though its colours consist only of black and white, yet the plumage of one seen in a perfect state of nature will excite a very high sensation of beauty. The pica may easily be brought up in a state of domestication, and will speak with great ease many phrases with all the readiness of the parrot, though not with his distinct and accurate enunciation. It constructs its nest with peculiar dexterity, not only covering the bottom with materials of a soft and downy texture, for the comfort of its young, but fixing the entrance at the side, and wattling a complete roof for its habitation, which is thus rendered warm, dry, and secure.

6. The graculus, or red-legged crow, is common on the coasts of Devonshire and Cornwall; and is to be found in Kent, Wales, and Scotland also. It is a turbulent, bold, and clamorous bird, builds in rocky situations, is voracious, and often seen snatching from its companions locusts or juniper berries, which constitute its favourite food. It is fond of glare, and has been known to snatch up burning sticks from the hearth, and place them in situations where, if unobserved, they must have produced destructive conflagrations.

CORVUS, the raven, in astronomy, a constellation of the southern hemisphere, wherein, according to Ptolemy and Tycho's Catalogue, are seven stars; whereas the Britannic Catalogue reckons

CORYLUS [illegible] hazel, a genus of the polyandria order, in the monœcia class of plants; and in the natural method ranking under the 50th order, amentaceæ. There are three species with many varieties, C. avellana, common hazel nut tree, is properly a shrub, the trunk of which is covered with a whitish bark, which is smooth on the branches, frequently of a bay colour, spotted with white; the shoots are sometimes hairy, ash-coloured, and green, with white tubercles. The male catkins appear in autumn, and wait for the expansion of the female germs in spring; the styles are of a bright red colour, long, and setaceous; the flowering branches, especially those which bear the fertile flowers, are set with short fine hairs, terminating in globules; the catkins are in pairs, and of a yellowish-green colour.

CORYMBIUM, a genus of the monogamia order, in the syngenesia class of plants, in the natural method ranking under the 49th order, compositæ. There are four species.

CORYMBUS, properly denotes a cluster of ivy berries. Among botanists, it is a mode of flowering, in which the lesser flower stalks are produced along the common stalk on both sides, rising to the same height.

CORYPHA, mountain palm, or umbrella-tree, a genus of the order of palmæ, belonging to the monœcia class of plants. The corolla is tripetalous; the stamina six, with one pistil; the fruit a monospermous plum. There are two species. The umbracula is a native of the West Indies, where it is called codda pana.

CORYPHÆNA, in ichthyology, a genus belonging to the order of thoracici. There are 12 species, most of them natives of foreign seas. The most remarkable are the blue and parrot fishes, described by Mr. Catesby. The head of the first is of an odd structure, resembling that of the spermaceti whale: the mouth is small, each mandible armed with a single row of even teeth, so closely joined that they seem entire bones; the iris of the eye is red. On the back is a long fin, indented on the edge; behind the gills are two fins, one under the abdomen and another behind the anus. The tail is forked; and the colour of the whole fish is entirely blue. They are taken on the coasts of the Bahama islands, and in most of the seas between the tropics.

COS, the *whetstone*, in natural history, a genus of vitrescent stones, consisting of fragments of an indeterminate figure, sub-opaque and granulated. Of this genus there are several species, some consisting of rougher and others of smoother, or even of altogether impalpable, particles; and used not only for whetstones, but also for mill-stones and other similar purposes.

Cos *Turcica, Turkey-stone*, a species of stones of the garnet kind, belonging to the siliceous class. It is of a dull white, and often of an unequal colour; some parts appearing more compact than others.

CO-*secant*, in geometry, the secant of an

arch which is the complement of another to 90°.

Co-*sine*, in trigonometry, the sine of an arch, which is the complement of another to 90°.

COSMOGRAPHY, a description of the *several parts of the visible world; or the art of delineating the several bodies according to their magnitudes, motions, relations, &c.* It consists of two parts, astronomy, and geography.

COSSACKS, or *Cosaks*, a military nation inhabiting the frontiers of the Russian empire, and constituting the principal defence against the incursions of the Tartars and other savage tribes.

COSTUS, in botany, a genus of the monandria-monogynia class of plants, the flower of which consists of three lanceolated, concave, equal petals, placed erect; the fruit is a roundish capsule, with three cells, containing several triangular seeds. There are three species. The root of this plant, or the costus Arabicus is given in obstructions of the menses, and in chronic cases, in which there are infarctions of the viscera.

CO-*tangent*, the tangent of an arch, which is the complement of another to 90°.

COTTON, a soft downy substance found on the gossypium, or cotton-tree. Cotton is separated from the seeds by a mill, and then spun and prepared for all sorts of fine work. The finest sort comes from Bengal and the coast of Coromandel. Cotton forms a very considerable article in commerce, and is distinguished into cotton-wool and cotton-thread.

Cotton, *manufacture of.* It will not be expected by those of our readers who have any knowledge of the nature of this most extensive branch of the commerce of Great Britain, that we should here enter into a description of the vast and ingenious machinery employed in the manufacture of cotton; even an outline of the subject would far exceed our limits. From the simple method of spinning by the domestic machine called the one thread wheel, which, during a long period, was the only method used in this country, improvements in machinery succeeded each other, notwithstanding the outrageous opposition of the labouring classes, with such rapidity that, at the present time, such is the perfection which this one branch of mechanics has attained, and such the progress that has been made in the application of it, Britain has nothing to fear from the ingenuity of her most powerful rivals. Many years must elapse before she can be equalled in the present stage of her progress; and she never stands still. Among those who deserve to have their names enrolled as valuable contributors to this great source of national wealth, the most prominent are those of Hargreaves, Arkwright, Crompton, Kelly, and Watt. It would be injustice to omit noticing here how much the *execution* of the most improved machinery is indebted to the skilful management of the persons who use it: a circumstance which is chiefly to be attributed to the noble efforts of such men as Birbeck, Ure, and others, to render workmen acquainted with the principles of the processes which it is their business to conduct.

COTTUS, or *Bull-head*, in ichthyology, a genus belonging to the order of thoracici. The head is broader than the body, and the gill-membrane has six rays. There are ten species, of which the principal is the gobio, the river bull-head. This is about five inches long when full grown, is found in almost every part of Europe in clear streams, and conceals itself *under a stone, or in the gravel. Its food consists of worms, aquatic insects, and extremely young fish. It is said to deposit its spawn in* a hole in the gravel formed by it for the purpose, and which nothing but necessity will induce it to leave. It is capable of swimming very vigorously and rapidly, but is far more stationary than active in its habit. It is used as food, but almost exclusively by the poor. The mailed bull-head, or cataphractus, is found in abundance in the seas of Europe.

COTYLEDON, *navel-wort*; a genus of the pentagynia order in the decandria class of plants; and in the natural method ranking under the 13th order, succulentæ. There are 19 species, most of them succulent perennials for the green-house; though some require to be kept in a stove. They rise from half a foot to a yard and a half high, and are adorned with yellow flowers growing in umbels.

COUCH, in painting, a term used for each lay or impression of colour, either in oil or water, with which the painter covers his canvas, wall, wainscot, or other matter to be painted.

COUCHANT, in heraldry, is understood of a lion, or other beast, when lying down, but with his head raised.

COUCHE', in heraldry, denotes any thing lying along: thus, chevron couche is a chevron lying sideways, with the two ends on one side of the shield, which should properly rest on the base.

COUCHING *of a cataract*, in surgery, one of the two chief methods of curing a cataract, by couching with the needle.

COVENANT, the agreement or consent of two or more by deed in writing, sealed and delivered; whereby either, or one of the parties, promises to the other, that something is done already, or shall be done afterwards.

A covenant is generally either in fact, or in law. In fact, is that which is expressly agreed between the parties, and inserted in the deed. In law, is that covenant which the law intends and implies, though it be not expressed in words.

CO-*versed sine*, in geometry, the remaining part of the diameter of a circle, after the versed sine is taken from it.

COVERT-*way*, or *Corridor*, in fortification, a space of ground, level with the field, on the edge of the ditch, three or four fathoms broad, ranging quite round the half-moons, and other works toward the country.

COVERTURE, in law, is applied to the condition of a married woman, who by the laws of this realm is sub potestate viri, and therefore disabled to make bargain with any, to the prejudice of herself or her husband.

COUGH, *tussis*, in medicine, a convulsive motion of the diaphragm, muscles of the larynx, thorax, and abdomen, violently shaking, and expelling the air that was drawn into the lungs by inspiration.

COULTER, in husbandry, an iron instrument fixed in the beam of a plough, and serving to cut the edge of each furrow. See Plough.

COUNCIL, or **Counsel**, *in a general sense, an assembly of divers considerable persons to concert measures relating to the state.*

COUNSELLOR *at law*, a person retained by a client to plead his cause in a public court of judicature. There are two degrees of counsel, viz. barrister and serjeants. Barristers are called to the bar after a certain period of standing in the inns of courts.

COUNT, a nobleman who possesses a domain erected into a county. The dignity is a medium between that of a duke and a baron.

Count *wheel*, in the striking part of a clock, a wheel which moves round once in 12 or 24 hours. It is sometimes called the locking-wheel.

COUNTER *barry* or **Contre** *barre*, in heraldry, is the same as our bendy sinister per bend counterchanged.

Counter *bond*, a bond of indemnification, given to one who has given his bond as a security for another's payment of a debt, or the faithful discharge of his office or trust.

Counter *changed*, in heraldry, is when any field or charge is divided or parted by any line or lines of partition, consisting all interchangeably of the same tinctures.

Counter *deed*, a secret writing either before a notary or under a private seal, which destroys, invalidates, or alters a public one.

Counter *ermine*, in heraldry, is the contrary to ermine, being a black field with white spots.

COUNTERFEITS, in our law, are persons that obtain any money or goods by counterfeit letters or false tokens, who being convicted before justices of assize, or of the peace, &c. are to suffer such punishment as shall be thought fit to be inflicted, under death, as imprisonment, pillory, &c.

COUNTERMARCH, in military affairs, a change of the face or wings of a battalion, by which means those that were in the front come to be in the rear. It also signifies returning or marching back again.

Counter-mine, in war, a well and gallery driven and sunk till it meets the enemy's mine, to prevent its effect.

Counter-paled, *contre palle*, in heraldry, when an escutcheon is divided into 12 pales, charged per fesse, the two colours being countercharged.

Counter-part, in music, denotes that one part is to be applied to another. Thus the bass is said to be the counterpart to the treble. In law, it is the duplicate, or copy of an indenture or deed.

Counterscarp, in fortification, is the exterior slope of the ditch, though it is often taken for the covered way and glacis. *Angle of the counterscarp* is that made by its two sides meeting before the middle of the curtain.

COUPLE *close*, in heraldry, the fourth part of a chevron, never borne but in pairs, except there be a chevron between them, saith Guillim, though Bloom gives an instance to the contrary.

COURSE, in navigation, that point of the compass or horizon on which the ship steers, or the angle between the rhumb-line and the meridian. See **Navigation**.

Course, in architecture, *a continued range of stones, level, or of the same height throughout the whole length of a building, without* being interrupted by any aperture.

Courses, in a ship, the mainsail and foresail: when the ship sails under them only, without lacing on any bonnets, she is said to go under a pair of courses. To sail under a main course and bonnets, is to sail under a mainsail and bonnet.

COURT. A court is a place appropriated to the judicial administration of justice.

The most general division of our courts is into such as are of record, or not; those of record are again divided into such as are supreme, superior, or inferior.

The supreme court of this kingdom is the high court of parliament, consisting of the king, lords, and commons, who are vested with an absolute authority in making laws, and repealing and reviving old ones.

Superior courts of record are the House of Lords, the chancery, king's bench, common pleas, and exchequer: the less principal ones are such as are held by commission of gaol-delivery, oyer and terminer, assize, nisi-prius, &c.

The inferior courts of record, are corporation courts, courtsleet, and sheriff's torn, &c.

Courts not of record, are the courts-baron, county-courts, hundred-courts, &c. Also the admiralty and ecclesiastical courts, which are not courts of record, but derive their authority from the crown, and are subject to the controul of the king's temporal courts where they exceed their jurisdiction.

Court-baron is a court which every lord of the manor has within its own precincts. This court is an inseparable ingredient of every manor; and if the number of the suitors should so fail as not to leave sufficient to make a jury or homage, that is, two tenants at least, the manor is lost. The court-baron may inquire into the death of tenants, nuisances, wastes, forfeitures, and the like; and the punishment is by amercement.

Court *of chancery*. See **Chancellor**.

COUSIN, a term of relation between the children of brothers and sisters, who in the first generation are called cousins-german, in the second generation, second cousins, &c.

COUSU, in heraldry, a piece of another colour or metal so placed on the ordinary as if sewed thereon.

COW, in zoology, the female of the ox kind. See **Bos**.

CRAB'S *claws*. See **Materia Medica**.

Crab's *eyes*. See **Pharmacy**.

Crab, an engine of wood, with three claws, placed on the ground like a capstan, and used at launching, or heaving ships into the dock.

CRADLE, in surgery, a case in which a broken leg is laid after being set.

Cradle, among shipwrights, a timber frame made along the outside of a ship by the bilge, for the convenience of launching her with ease and safety.

CRAFT, in the sea language, signifies all manner of nets, lines, hooks, &c. used in fishing. Hence all such little vessels as ketches, hoys, and smacks, &c. used in the fishing trade, are called small craft.

CRAMBE, *sea cabbage, sea kale*, or *sea*

colewort, a genus of the siliquosa order, in the tetradynamia class of plants, ranking in the natural method under the 39th order, siliquosæ. There are six species, three herbaceous esculents with perennial roots, producing annually large leaves, like those of the cabbage, spreading on the ground with yellow flowers. Only one species is a native of Britain, and it grows wild in several parts of the sea-coast. It is propagated by seeds sown in common light earth in autumn or spring. The crambe fruticosa is a green house plant.

CRAMERION, a genus of the monogynia order, in the tetrandria class of plants.

CRAMPONEE, in heraldry, a cross which has at each end a cramp or square piece coming from it.

CRANE. See GRUS.

CRANE, in mechanics, signifies a machine for raising and lowering heavy bodies and large weights, and removing them from one place to another within the sweep of its arm, which revolves on a centre.

The parts of a crane are, the post or upright, which is either moveable or turns upon pivots; the gib, an arm extending from the upper part of the post; and the stay, intended for a support to the gib, and fixed in a diagonal direction from the gib to the bottom of the post. These with the requisite wheels, pullies, and levers, complete the crane.

Mr. James Ferguson appears to have been the first who introduced any improvement of importance in the construction of cranes. His crane with three trundles, having different numbers of stones, is well known. Cranes have been generally constructed of timber; but cast and unrought iron have been lately introduced, and with decided advantage; both as it regards the effects which the weather must always be expected to produce on such machines; and also as it respects the combination of its parts in having the strength duly proportioned, and in adapting its formation to any situation or circumstance. The greatest improvement in the construction of cranes is due to Mr. Bramah, who has ingeniously contrived to connect with them the almost boundless power of the hydraulic press.

CRANICHIS, a genus of the class and order gynandria decandria. The essential character is, nectary galeated. There are five species.

CRANIOLARIA, a genus of the angiospermia order, in the didynamia class of plants; and in the natural method ranking under the 40th order, personatæ. There is one species, a native of New Spain, but not possessed of any remarkable property.

CRANK, a contrivance in machines, in manner of an elbow, only of a square form, projecting from a spindle, and serving by its rotation to raise and lower the pistons of engines.

CRANK likewise denotes the iron support for a lantern, and also the iron made fast to a stock of a bell for ringing it.

CRANZIA, a genus of the pentandria monogynia class and order. There is one species, a native of the East Indies.

CRAPE, a light transparent stuff, in manner of gauze: made of raw silk gummed and twisted on the mill, woven without crossing, and much used in mourning. The invention of this stuff came originally from Bologna; but, till of late years, Lyons is said to have had the chief manufacture of it.

CRASPEDIA, a genus of the class and order syngenesia polygamia segregata. There is one species, a native of New Zealand.

CRASSULA, lesser orpine, or live-ever; a genus of the pentagynia order, in the pentandria class of plants; and in the natural method ranking under the 13th order, succulentæ. There are 64 species, all of them natives of warm climates. Several of them are cultivated in this country, but require the assistance of artificial heat for their preservation.

CRATÆGOS, wild service-tree, hawthorn, &c. a genus of the digynia order, in the icosandria class of plants; and in the natural method ranking under the 36th order, pomaceæ. There are 23 species. This genus consists chiefly of shrubs or trees, hardy and deciduous; leaves simple, undivided, or lobed; peduncles in most species many flowered; corymbed terminating, and solitary from the axils; corollas white, appearing in May and June, and succeeded by red berries in autumn.

CRATER, in astronomy, a constellation of the southern hemisphere, consisting of seven stars according to Ptolemy's Catalogue, of eight in Tycho's, and eleven in the Britannic Catalogue. The term is also used to signify the mouth or opening of a volcanic mountain.

CRATEVA, the garlic pear; a genus of the monogynia order in the dodecandria class of plants; and in the natural method ranking under the 25th order, putamineæ. There are five species, natives of both Indies. They are of the tree kind; and are chiefly distinguished by their fruit. The tapia, or garlic pear, has a smooth round fruit about the size of an orange, with a hard brown shell or cover, which incloses a mealy pulp, filled with kidney-shaped seeds. It has a strong smell of garlic. The marmelos grows to the size of a very large tree, with trifoliate leaves. The flowers have the smell of roses, and are succeeded by an oblong fruit of the size of an apple, covered with a very hard bony shell, and containing a soft fleshy pulp, having the taste of quinces. From the flowers of this plant is obtained by distillation a water highly odoriferous and cordial; and the pulpy part of the fruit is prepared into various kinds of marmalades.

CRAX, in ornithology, the curasson, a genus of birds belonging to the order of gallinæ. The base of the beak of each mandible is covered with wax; and the feathers of the head are curled. There are five species, viz. 1. the alecator, or Indian hen of Sloane, is about the size of a small turkey. They are frequent at Guiana, and form a very considerable article of food to the inhabitants. 2. The rubra, or Peruvian hen, is red, with a bluish head. These birds are natives of Mexico and Peru. They are frequently kept tame in our menageries in England, and readily mix with other poultry, feeding on bread and grain. 3. The mitu, or Brazilian pheasant, is black, with a dusky belly; it is a native of Guinea and Brazil. 4. The globicera, has a yellow protuberance between the nostrils, and is of a bluish black colour: it is likewise a native of Brazil. 5. The pauxi, or Mexican phea-

sant of Brisson, is of a bluish colour, with blue wax, and the tip of the tail and belly white.

CRAY-FISH, or CRAW-FISH. See CANCER.

CRAYONS, are coloured substances, which naturally possess, or are reduced by art, to the texture of chalk; they are used for sketching and painting in their dry state, in the form and manner of a black lead pencil. As crayons may be obtained of any requisite colour, and prepared in the very best manner at any of the respectable colour shops, it is unnecessary to give directions here for their preparation. Crayon painting is generally executed on strong blue paper, which should be freed from its knots by cutting them with a sharp knife, or rubbing them down with a piece of flat pumice-stone.

After this is done the paper must be pasted very smooth on a linen cloth, previously strained on a deal frame, the size according to the artist's pleasure: on this the picture is to be executed: but it is most eligible not to paste the paper on till the whole subject is first dead-coloured. The method of doing this is very easy, by laying the paper with the dead-colour on its face, upon a smooth board or table, when, by means of a brush, the back of the paper must be covered with paste; the frame with the strained cloth must then be laid on the pasted side of the paper; after which turn the painted side uppermost, and lay a piece of clean paper upon it, to prevent smearing it: this being done, it may be stroked gently over with the hand; by which means all the air between the cloth and the paper will be forced out.

When the paste is perfectly dry, the student may proceed with the painting. The advantages arising from pasting the paper on the frame according to this method, after the picture is begun, are very great, as the crayons will adhere much better than in any other way; which will enable the student to finish the picture with a firmer body of colour, and greater lustre.

CREAM. See MILK.

CREAM *of tartar*, the common name of supertartrate of potash; it is also denominated crystals of tartar. In this salt there is an excess of the TARTARIC acid, which see.

CREPIS, bastard hawk-weed, a genus of the polygamia order, in the syngenesia class of plants, and in the natural method ranking under the forty-ninth order, compositæ. There are twenty species, most of them herbaceous annuals, rising to the height of a foot or a foot and a half, and having their branches terminated by compound red and yellow flowers. These are very large, and consist of many flat florets, which are succeeded by plenty of seed, which, if permitted to fall on the ground, will produce a number of young plants without further trouble.

CREPITATION, that noise which some salts make over the fire in calcination, called also detonation.

CREPUSCULUM, in astronomy, twilight: the time from the first dawn or appearance of the morning to the rising of the sun; and again, between the setting of the sun and the last remains of day. The crepusculum is computed to begin and end when the sun is about eighteen degrees below the horizon. It is of longer duration in the solstices than in the equinoxes, and longer in an oblique than in a right sphere. The crepuscula are occasioned by the sun's rays refracted in our atmosphere.

CRESCENT, in heraldry, a bearing in form of a new moon.

CRESCENTIA, the calabash tree; a genus of the angiospermia order, in the didynamia class of plants; and in the natural method ranking under the 25th order, putamineæ.

There are two species, viz. 1. The cujete, narrow leaved calabash-tree. 2. The cucurbitina broad leaved calabash tree. These are small trees, with large leaves, either singly, alternate, or in alternate bundles. Flowers on the trunk or branches sub-solitary; they are both natives of the West Indies.

CRESSA, in botany, a genus of plants of the class and order pentandria digynia. The essential character is calyx five leaved: corolla, salver-form; filaments sitting on the tube; capsule two valved. There are two species.

CREST, in armoury, the top part of the helmet, generally ornamental. In heraldry, it is that part of the casque or helmet next the mantle.

CRINODENDRUM, in botany, a genus of plants of the class and order monadelphia decandria. Calyx none, corolla bell-shaped, six petalled; capsula one celled, gaping at the top. It is a native of Chili.

CRINUM, a genus of the monogynia order, in the hexandria class of plants, ranking in the natural method under the 9th order, spathaceæ. It is a beautiful greenhouse plant, about three feet high, having large funnel-shaped flowers, blue, white, or striped, and a very fragrant smell. There are six species.

CRITICISM, from the Greek word κρινω, signifies, in general, the art of judging: but, in its more restrained and usual sense, denotes the art of judging with propriety concerning the nature of literary compositions.

CROCODILE. See LACERTA.

CROCUS, in botany, a genus of the triandria monogynia class and order. Natural order ensatæ. There are two species with many varieties, viz. C. officinalis, officinal crocus, or saffron, and C. vernus, or spring crocus.

CROISADE, CRUSADE, or CRUZADO, a name given to the expeditions of the Christians against the Infidels, for the conquest of Palestine; so called because those who engaged in the undertaking wore a cross on their clothes, and bore one on their standard.

CROMLECHS, in British antiquities, are huge, broad, flat stones, raised upon other stones set up on end for that purpose. They are common in Anglesea. They are supposed by some persons to have been tombs, though others imagine that they were altars for religious services.

CROSLET, in heraldry, is when a cross is crossed again at a small distance from each of the ends.

CROSS, in heraldry, is an ordinary composed of fourfold lines, whereof two are perpendicular, and the other two transverse. The content of a cross is not always the same; for when it is not charged, it has only the fifth part of the field.

CROSSELET, a little or diminutive cross,

used in heraldry, where the shield is frequently seen covered with crosselets.

CROSSOTYLUS, a genus of the polyandria order, in the monadelphia class of plants. There is one species, a native of the Society Isles.

CROTALARIA, *rattle-wort*, a genus of the decandria order, in the diadelphia class of plants, and in the natural method ranking under the 32d order, papilionaceæ. There are 32 species, all of them natives of warm climates. They rise from eighteen inches to five feet in height, and are adorned with flowers of a red, blue, or yellow colour. The most remarkable species is the retusa. It is a native of the East Indies. The flowers are yellow; the pods smooth, and placed horizontally; they are filled with seeds, which, when dried, and shaken by the lightest wind, produce a rattling noise; and this, by the inhabitants of the countries where the plant is native, is attributed to the devil, who is thought to deliver his oracles in this whimsical manner.

CROTALUS, *rattle-snake*, a genus belonging to the order of amphibia serpentes, the generic character of which is, scuta on the abdomen; scuta and squamæ beneath the tail; rattle terminating the tail.

1. Crotalus horridus, or banded rattle-snake. The genus crotalus, or rattle-snake, affords the most signal examples of the powerfully destructive poison with which some of the serpent tribe are furnished.

This species is found, in general, from three to four or five feet in length: and is of a yellowish-brown colour; the head is large, flat, and covered with small scales; the rest of the upper parts with large oval ones. At the extremity of the tail is situated the rattle, consisting of several hard, dry, horny processes, and which, on the least disturbance or irritation, is elevated and shaken in such a manner as to cause a strong or brisk rattling sound.

2. Crotalus durissus, or striped rattle snake. This species may be distinguished from the former by the different disposition of its colours; being of a deep brown above, with pale yellow streaks forming a continued series of lozenges down the back. It is also a native of America. Its bite, appears to be equally fatal with that of the former species.

3. Crotalus dryinas, or wood rattlesnake. This is said to be of a paler tinge than the two former species, and variegated with yellowish marks on the back.

4. Crotalus miliarius, or miliary rattlesnake. It is of a grey-brown, shaded on the back with red, and marked by large black spots with white edges. This is the smallest species of rattlesnake yet known, rarely exceeding the length of two feet. In its general habits it resembles the preceding kinds.

CROTCHET, in music, one of the notes or characters of time, equal to half a minim, and double of a quaver. A dot added to the crotchet, increases its time by one-half. See Music.

Crotchets, marks or characters, serving to inclose a word or sentence, which is distinguished from the rest, being generally in the form [ ], or this ( ).

CROTON, *wild ricinus*, a genus of the monadelphia order, in the monœcia class of plants, and in the natural method ranking under the 38th order, tricoccæ. There are 53 species. The plants of this numerous genus are herbaceous, or more frequently shrubby. Leaves accompanied with stipules, generally alternate, seldom opposite: flowers axillary, or terminating usually in spikes; but sometimes in corymbs: the spikes are mostly monaecous. These plants are chiefly inhabitants of the East and West Indies.

CROTOPHAGA, in ornithology, a genus of birds belonging to the order of picæ. The most remarkable species is the ani, which is about the size of a blackbird: the colour of the whole bird is black, in some parts glossed with purple, and about the neck faintly tinged with green on the margins. This species is found in Jamaica, St. Domingo; also at Cayenne, and other parts of South America. Contrary to the custom of all other birds, they have the singularity of many lying in the same nest; to make which they all unite in concert, and, after laying their eggs, sit on them close to each other to hatch them, each striving to do the best for the general good: and when the young are hatched, the parents, without reserve, do their best to feed the whole flock.

CROUP *of a horse*, is the extremity of the reins above the hips.

CROW. See Corvus.

Crow, in mechanics, a kind of iron lever sharp at one end, and a claw at the other, used for heaving or pushing great weights.

CROWN, in heraldry, is used for the representation of that ornament, in the mantling of an armoury, to express the dignity of persons.

Crown, *the imperial*, is a bonnet or tiara, with a semicircle of gold, supporting a globe with a cross at top.

Crown, in architecture, the upper member of the cornice.

Crown, in astronomy, a name for two constellations, the one called borealis, the other meridionalis.

Crown, in geometry, a plane ring, included between two concentric perimeters, generated by the motion of part of a right line round the centre, to which the moving part is not contiguous.

The area of a crown is had by multiplying its breadth by the length of the middle periphery; for a series of terms in arithmetic progression being $n \times \frac{a+w}{2}$, *i. e.* the sum of the first and last multiplied by half the number of terms, the middle terms must be $\frac{a+w}{2}$; therefore, that multiplied by the breadth or sum of all the two terms will give the crown.

Crown-*wheel of a watch*, the upper wheel which by its motion drives the balance. In royal pendulums it is called the swing-wheel.

Crown-*work*, in fortification, an outwork having a large gorge, and two long sides terminating towards the field in two demi-bastions. It is intended to inclose a rising ground, or to cover an intrenchment.

CRUCIANELLA, petty madder, a genus of the monogynia order, in the tetrandria class of plants; and in the natural method ranking under the 47th order, stellatæ. There are nine species, natives of the southern parts of Europe; but none of them possessed of any remarkable quality.

CRUCIBLE, a chemical vessel made of earth, and so tempered and baked as to endure the greatest fire. They are used to melt metals, and to flux minerals, ores, &c.

CRUIZERS, in naval affairs, vessels, employed on a cruize. They are, in truth, small men of war made use of to secure our merchants' ships and vessels from the enemy's small frigates and privateers. They are generally formed for sailing well, and are commonly well manned. The safety of the trade in the Channel requires that ships of this description should be kept out at sea.

CRUSTACEOUS *fish*, in natural history, those covered with shells, consisting of several pieces or scales, as those of crabs, lobsters, &c. They are generally softer than the shells of the testaceous kind, which consist of a single piece, and commonly thicker and stronger than the former; such as those of the oyster, scallop, cockle.

CRYPTOGAMIA, one of Linnæus's classes of plants, the organs of fructification of which are either concealed within the fruit itself, or so minute as to escape observation. It embraces 4 orders: filices, musci, algæ, and fungi, which see.

CRYPTOSTOMUM, a genus of the pentandria class and order. There is one species, a shrub of Guiana.

CRYSTAL, in natural history, the name of a very large class of fossils, hard, pellucid, and naturally colourless.

CRYSTALLIZATION. The word crystal *originally signified* ice; but it was afterwards applied to crystallized silica, or rock crystal. Chemists have applied the word to all transparent bodies of a regular shape; and at present it is employed to denote in general the regular figures which bodies assume when their particles have full liberty to combine according to the laws of cohesion. These regular bodies occur very frequently in the mineral kingdom, and have long attracted attention on account of their great beauty and regularity. By far the greater number of the salts assume a crystalline form; and as these substances are mostly soluble in water, we have it in our power to give the regular shape of crystals in some degree at pleasure.

All the substances with which we are acquainted may be divided into solid, liquid, and gaseous Crystals are obviously confined to the first set, the fluidity of the two last rendering them incapable of retaining a regular form; but many of them may be made to assume a solid state, and in that case they usually crystallize. Most solid bodies either occur in the state of crystals, or are capable of being made to assume that form. There is a particular form which every substance always affects when it crystallizes. Thus common salt is observed to assume the shape of a cube; and alum that of an octahedron, consisting of two four-sided pyramids, applied base to base. Saltpetre assumes the form of a six-sided prism: sulphat of magnesia, that of a four-sided prism; and carbonate of lime that of a rhomboid. This, however, is liable to considerable variations, according to the circumstances of the case; but there are a certain number of forms peculiar to every substance; and the crystals of that substance, in every case, adopt one or other of these forms, and no other.

As the particles of bodies must be at liberty to move before they crystallize, it is obvious that we cannot reduce any bodies to the state of crystals, except those which we are able to make fluid.

Solution is the common method of crystallizing salts. They are dissolved in water; the water is slowly evaporated; the saline particles gradually approach each other, combine together, and form small crystals; which become constantly larger by the addition of other particles, till at last they fall by their gravity to the bottom of the vessel. Or a saturated solution being prepared in hot water, it is set by to cool. On the escape of the caloric, by which the solution was in great part accomplished, the salt crystallizes. Such salts commonly form in groups, attached to the sides or bottom of the vessel, or depending from a pellicle. They usually contain more water of crystallization than the former class.

There are many substances, however, neither soluble in water nor other liquids, which, notwithstanding, are capable of assuming a crystalline form. This is the case with the metals, with glass, and some other bodies. The method employed to crystallize them is fusion, which is a solution by means of caloric alone. By this method particles are separated from one another; and if the cooling proceeds gradually, they are at liberty to arrange themselver in regular crystals.

As to the theory of crystallization it may be sufficient here to remark that Haüy, and other chemists of eminence, have assumed that the primitive molecules of matter have three distinct forms, viz. the tetraedron, the simple prism, and the cube; and that these figures form every crystal in nature, and by a certain arrangement with respect to each other, completely fill space. This theory has been found insufficient to account for all the phenomena attending the process of crystallization.

Dr. Wollaston, in order to obviate the difficulties thence arising, has ingeniously proposed to consider the primitive particles of matter as spheres, which, by mutual attraction, have assumed that arrangement which brings them as near as possible to each other. This, however, must be understood with limitation. Dr. Wollaston does not consider the particles as perfectly spherical, but, like Haüy, divides their forms into three classes, viz. the sphere, the spheroid, and the oblong sphere, or ellipsoid. Others are of opinion that the primitive particles of matter are perfectly spherical. This opinion was, we believe, originally advanced, and very ingeniously supported by Mr. Gurney in his lectures at the Surrey Institution.

Great attention has of late been paid to the measuring of the angles of crystals. The instrument used for this purpose is called a goniometer, of which there are two kinds.

1. The goniometer of M. Carangeau, used by M. Haüy, consists of two parallel blades, jointed like those of scissars, and capable of being applied to a graduated semicircular sector, which gives the angle to which the joint is opened, in consequence of the previous apposition of the two blades to the angle of the crystal. 2. The reflective goniometer of Dr. Wollaston; an admirable invention, which measures the angles of the minutest possible crystals with the utmost precision. An account

of this beautiful instrument may be found in the Phil. Trans. for 1809, and in Tilloch's Magazine for February 1810, vol. 35.

CUBÆA, in botany a genus of the decandria monogynia class and order. Calyx turbinated, five-parted, unequal, permanent; petals, five, unequal; filaments villose, three shorter; germen pedicelled; legume villose; six or seven seeded. There are two species.

CUBE, or hexahedron, a solid regular body, consisting of six equal square sides. It is supposed to be generated by the motion of a square plane along a line equal and perpendicular to one of its sides.

To determine the surface and solidity of a cube. Multiply one side by itself, which will give one square; this multiplied by 6 will give the whole surface. Also multiply one side twice by itself, that is, cube it, and that will give the solid content.

CUBES or *cubic numbers*, are formed by multiplying any numbers twice by themselves. Thus the cubes of 1, 2, 3, 4, 5, 6, &c. are 1, 8, 27, 64, 125, 216, &c.

CUBE, *duplication of the*, is the finding of the side of a cube that shall double in solidity a given cube. It cannot be done geometrically, as it requires the solution of a cubic equation, or the finding two mean proportionals. Let a be the side of the given cube, and z that of the double one, then $z^3 = 2a^3$, or $a^2 : z^2 :: z : 2^a$, therefore if a and z be the 1st and 2d terms of a set of continued proportionals, then $a^2 : z^2$ is the ratio of the square of the 1st to that of the 2d, which is the same as the ratio of the 1st term to the 3d, or the 2d to the 4th, or of z to 2^a; therefore, z being the 2d term, 2^a will be the 4th, so that z the side of the cube sought, is the 2d of 4 terms in continued proportion; the 1st and 4th being a and 2^a, *i. e.* the side of the double cube is the 1st of two mean proportionals between a and 2^a.

CUBE, or *cubic number*, in arithmetic, is that produced by the multiplication of a square number by its root.

CUBE *root of any number, or quantity*, such a number, or quantity, which, if multiplied into itself, and then, again, the product thence arising, by that number or quantity, being the cube root, this last product shall be equal to the number or quantity whereof it is the cube root; as 2 is the cube root of 8, because two times 2 are 4, and two times 4 are 8; and $a+b$ is the cube root of $a^3+3a^2b+3ab^2+b^3$.

CUBIT, in the mensuration of the ancients, a long measure, equal to the length of a man's arm, from the elbow to the tip of the fingers. Dr. Arbuthnot makes the English cubit equal to 18 inches; the Roman cubit equal to 1 foot, 5.406 inches; and the cubit of the Scripture equal to 1 foot, 9.888 inches.

CUCKOW. See CUCULUS.

CUCKOW *spit*. See CICADA.

CUCUBALUS, berry-bearing chickweed, a genus of the trigynia order in the decandria class of plants, and in the natural method ranking under the 22d order, caryophylei. There are 17 species; the most remarkable of which are,

1. The behen, Swedish lychnis, or gumsepungar, a native of several parts of Europe. The flower is curiously wrought like a network, and is of a purplish colour. The leaves have somewhat of the flavour of peas: the Gothlanders apply them to erysipelatous eruptions.

2. The catholicus, or night-flowering lychnis, grows naturally in Spain and Italy. It is a perennial plant, rising with an upright branching stalk, a foot and a half high. The flowers are closed all the day; but at night when the sun has left them, they expand, and emit an agreeable smell.

3. The otites, or catch-fly, is a native of Britain and other European countries. It has a thick, fleshy, perennial root, which strikes into the ground, whence rises a jointed stalk three or four feet high. At the joints there exudes a viscous clammy juice, that sticks to the fingers when handled; and the small insects which settle upon those parts of the stalks are so fastened that they cannot get off. The flowers are small, and of a greenish colour.

CUCUJUS, a genus of insects of the coleoptera order: antennæ filiform; feelers four, equal, the last joint truncate and thicker; lip short, bifid; the divisions linear and distant; body depressed. There are 11 species belonging to this genus.

CUCULLANUS, a genus of worms of the order intestina: body sharp, pointed behind and obtuse before; mouth orbicular, with a striated hood. They are most of them viviparous. There are eight species, which take their names from the animal in which they are found.

CUCULLARIS. See ANATOMY.

CUCULUS, the cuckow, in ornithology, a genus belonging to the order of picæ. There are 46 species. The most remarkable are:

1. The canorus, or common cuckow, weighs about five ounces, and is in length 14 inches, in breadth 25. The bill is black, and about two-thirds of an inch in length. The head, hind part of the neck, coverts of the wings and rump, are of a dove-colour, darker on the head and paler on the rump. The legs are short, and the toes disposed two backwards and two forwards, like those of the wood-pecker. This bird appears in our country early in the spring, and makes the shortest stay with us of any bird of passage. It takes its departure about the beginning of July. Some of these birds, however, have been found to winter in this island, taking up their abode in hollow trees, where they have lain in a torpid state. The cuckow does not rear her own offspring, but selects the nest of some other bird, particularly that of the hedge sparrow, in which she deposits her eggs. When the sparrow has sat her usual time, and disengaged the young cuckow, and some of her own offspring from the shell, her own young ones are soon turned out by the intruder, who remains in possession of the nest. There are many more male cuckows than females; for when five or six have been taken in a trap, not a female has been found among them. Cuckows may be brought up tame. They will eat bread and milk, fruit, insects and flesh. 2. The indicator or honey guide is a native of Africa, particularly in the interior parts from the Cape of Good Hope, where it guides by its note the persons who go in search of wild honey. 3. The capensis, or Cape cuckow, is somewhat smaller than the European. It also inhabits the Cape of Good Hope. 4. The honoratus or sacred cuckow, inhabits Malabar, and feeds on reptiles. The

inhabitants hold it in great veneration. 5. The vetula is larger than a blackbird, and is a native of Jamaica. It is very tame and easily taken. It feeds on lizards, frogs, small snakes, and young rats and birds. It is called the rain-bird, from its making a great noise before rain. 6. The cayanus, or Cayenne cuckow, is of the same size with the preceding. The inhabitants of Cayenne call it the devil, and account it a bird of bad omen.

CUCUMIS, in botany, a genus of the monœcia syngenesia class and order. Natural order of cucurbitaceæ. There are 13 species. These are all annual plants, with herbaceous scandent stems. The sativus, common cucumber, generally cultivated for the tables, is so well known, as not to require a particular description. The melo, common or musk melon, belongs to this genus. There is a great variety of this fruit cultivated in this country, especially by those who supply the markets, where their size is chiefly regarded, so that by endeavouring to increase their bulk, the fruit becomes of little value.

CUCURBITA, in botany, a genus of the monœcia syngenesia class and order. Natural order of cucurbitaceæ. There are seven species. The plants of this genus are very nearly allied to those of cucumis, and are distinguished from it chiefly by the swelling rim of the seed. Like them they are annual, with trailing herbaceous stems, furnished with tendrils for climbing.

CUIRASS, a piece of defensive armour, made of iron plate, well hammered, serving to cover the body from the neck to the girdle, both before and behind.

CULEX, the gnat, a genus of insects belonging to the order of diptera. The mouth is formed by a flexible sheath, inclosing bristles pointed like stings. The antennæ of the males are filiform; those of the females feathered. There are seven species. These insects are well known by the severe punctures they ininflict, and the itchings thence arising. Before they turn to flying insects, they have been in some measure fishes, under two different forms. "You may observe in stagnate waters," says Barbut, "from the beginning of May till winter, small grubs with their heads downward, and their hinder parts on the surface of the water; from which part arises sideways a kind of vent-hole, or small hollow tube like a funnel; and this is the organ of respiration. These larvæ retain their form during a fortnight or three weeks, after which period they turn to chrysalids. After three or four days the chrysalis passes to the state of a gnat. A moment before, water was its element; but now it becomes an aerial insect, and can no longer exist in water. The sting of the gnat is a tube, containing five or six spicula of exquisite minuteness; some dentated like the head of an arrow, others sharp-edged like razors. These spicula, introduced into the veins, act as pump-suckers, into which the blood ascends. The insect injects a small quantity of liquor into the wound, by which the blood becomes more fluid, and is seen through the microscope passing through these spicula. The pain occasioned by the string may be removed by washing the part affected with volatile alkali, or with a little vinegar. Gnats engender in the air. The female deposits her eggs on the water, placing them one by the side of another in the form of a little boat. This vessel, composed of two or three hundred eggs, swims on the water for two or three days, after which they are hatched. If a storm arises, the boats are sunk. Every month there is a fresh progeny of these insects. Were they not devoured by swallows, other birds, and by several carnivorous insects, the air would be darkened by them."

CULMINATION, in astronomy, the passage of any heavenly body over the meridian, or its greatest altitude for that day.

CULMUS, in botany, a straw, or haulm, the proper trunk of grasses which elevates the leaves, flower, and fruit.

CUMINUM, *cummin*, a genus of the digynia order, in the pentandria class of plants, and in the natural method ranking under the 45th order, umbellatæ. The fruit is ovate and striated; there are four partial umbels, and the involucra are quadrifid. There is but one species, viz. the cyminum. It is an annual plant, perishing soon after the seed is ripe. It rises nine or ten inches high in the warm countries, where it is cultivated, but seldom rises above four in this country.

CUNILA, in botany, a genus of the monogynia order, in the monandria class of plants, and in the natural method ranking under the 42d order, verticillatæ. There are four species, none of which has any remarkable property.

CUNNINGHAMIA, a genus of the tetrandria monogynia class and order. There is one species.

CUNONIA, a genus of the digynia order in the decandria class of plants, and in the natural method ranking with those of which the order is doubtful. There is one species, a native of the Cape.

CUOGOLO, in natural history, the name of a stone much used by the Venetians in glass making, and found in the river Fesino. It is a small stone of an impure white, of a shattery texture, and is of the shape of a pebble.

CUP-*galls*, in natural history, a name given by authors to a very singular kind of galls, found on the leaves of the oak and some other trees. They are of the figure of a cup, or drinking-glass without its foot, being regular cones adhering by their point or apex to the leaf; and the top or broad part is hollowed a little way, so that it appears like a drinking class with a cover.

CUPANIA, a genus of the monadelphia order, in the monœcia class of plants, and in the natural method ranking under the 38th order, tricoccæ. There are three species, small trees of the West Indies, which possess no remarkable property

CUPEL, a shallow earthen vessel, somewhat resembling a cup, from which it derives its name. It is made of phosphate of lime, or the residue of burned bones rammed into a mould, which gives it its figure. This vessel is used in assays wherein the precious metals are fused with lead, which becomes converted into glass, and carries the impure alloy with it. See ASSAY.

CUPELLATION. The refining of gold by scorification with lead upon the cupel, is called cupellation. See ASSAY.

CUPOLA, in architecture, a spherical

vault; or the round top of the dome of a church, in form of a cup inverted.

CUPPING, in surgery, the operation of applying cupping-glasses for the discharge of blood, and other humours, by the skin.

CUPRESSUS, the cypress-tree, a genus of the monadelphia order, in the monœcia class of plants, and in the natural method ranking under the 51st order, coniferæ. There are seven species; the most remarkable are the following: 1. The sempervirens, or evergreen, with an upright straight stem, closely branching all round, into numerous quadrangular branches, rising in the different varieties from 15 to 40 or 50 feet in height, with small, narrow, erect evergreen leaves. 2. The thyoides, or evergreen American cypress, commonly called white cedar, has an upright stem branching out into numerous two-edged branches, rising 20 or 30 feet high, ornamented with the flat evergreen leaves, imbricated like the arbor vitæ, and small blue cones, the size of juniper-berries. 3. The disticha, or deciduous American cypress, grows 50 or 60 feet high, with small spreading deciduous leaves, arranged distichous, or along two sides of the branches. All these species are raised from seeds, and will sometimes also grow from cuttings; but those raised from seeds prove the handsomest plants.

The wood of the first species is said to resist worms, moths, and putrefaction, and to last many centuries. The same tree has been extolled as a remedy in pulmonic diseases, from its supposed property of meliorating the air by its balsamic exhalations.

CURATELLA, a genus of the digynia order, belonging to the polyandria class of plants, and in the natural method ranking with those the order of which is doubtful.

CIRCULIO, in zoology, a genus of insects belonging to the order of coleoptera.

The larvæ of the curculiones bear a resemblance to oblong soft worms. Some species of them, that are dreaded for the mischief they do in granaries, find means to introduce themselves, while yet small, into grains of corn, and there make their abode. Corn-lofts are often laid waste by these insects, whose numbers are sometimes so great as to devour and destroy all the grain. When the insect is come to its full size, it remains within the grain, and there becomes a chrysalis.

CURCUMA, *turmeric*, a genus of the monogynia order, in the monandria class of plants, and in the natural method ranking under the eighth order, scitamineæ. It has four barren stamina, with a fifth fertile. There are three species: 1. The rotunda, with a round root, having a jointed root like that of ginger, but round. The flowers are of a pale yellow colour; and in this country are never succeeded by seeds. 2. The longa has long roots of a deep-yellow colour, which spread under; they are about the thickness of a man's finger. The flowers grow in loose spikes on the top of the footstalks; they are of a yellowish-red colour, and shaped like those of the Indian reed. 3. The pallida, which differs from the others in being an annual plant. These plants grow naturally in India, whence the roots are brought to Europe for use. They are used in dying yellow, and in medicine as a remedy for the jaundice.

CURFEW, in the law Latin of the middle ages, *ignitegium*, or *pyritegium*, and in French *couvre-feu*, was a signal for all persons to extinguish their fires at a certain hour. In those times people generally made their fires in holes dug in the centre of the floor, under an opening formed in the roof; and when the fire was to be extinguished, or when the family went to bed, the whole was shut by a cover of wood or earth. Hence in the dark ages, when all ranks were turbulent, a law was established that the fire should be extinguished at a certain hour in the evening; that the cover should be put over the fire place, and that all the family should retire to rest or at least keep within doors. The signal for this was given by the ringing of a bell, which was therefore called the curfew bell.

CURRANS, or CURRANTS. See RIBES.

CURRANTS, also signify a smaller kind of grapes brought principally from Zante and Cephalonia. They are gathered off the bunches, and laid to dry in the sun, and so put up in large butts.

CURRENT, in hydrography, a stream or flux of water in any direction. In the sea, currents are either natural, occasioned by the diurnal motion of the earth round its axis, or accidental, caused by the waters being driven against promontories, or into gulphs and straits, where wanting room to spread, they are driven back, and thus disturb the ordinary flux of the sea. Dr. Halley makes it highly probable that in the Downs there are under-currents, by which as much water is carried out as is brought in by the upper currents.

CURRYING, the method of preparing leather with oil, tallow, &c. The chief business is to soften and supple cows' and calves' skins, which make the upper-leathers and quarters of shoes, coverings of saddles, coaches, and other articles which must keep out water.

When the skins are brought from the tanner's yard, they are first soaked for some time in common water, and when taken out, are stretched on a smooth wooden horse. The currier scrapes off with a paring-knife all the superfluous flesh, and immerses them again. They are next put on a wet hurdle, and trampled with the heels, till they become soft and pliant, when they are steeped in train oil, and afterwards spread out on large tables, and their ends secured. Tallow and oil are rubbed in with a polished stone. The oil could not be rubbed in, unless the hides were well soaked and wetted through with water; the oil occupying the place of the *extract*, which is evaporated by drying.

The skins are afterwards spread out on large tables, and their ends secured by means of a *pummel*, an instrument consisting of a thick piece of wood, the lower side of which is full of furrows, or teeth, crossing each other. The skins are then folded, squared, and moved in various directions, to render them supple. The skins are now coloured black, white, red, green, &c. which process is performed either on the *flesh* or *grain* side; that on the former, by skinners, and that on the *grain* or *hair* side by curriers. When a skin is to be made

white, it is rubbed with chalk, or white-lead, and afterwards with pumice-stone. But, when a black colour is wanted, the skin must be first oiled and dried, then passed over a puff, dipped in water impregnated with iron, when it is immersed in another water prepared with soot, vinegar, and gum-arabic. Thus it gradually acquires a deep dye, and the operations are repeated till it becomes of a shining black.

CURSITOR, an officer or clerk belonging to the chancery, who makes out original writs; of these there are 24 in number, and to each are allotted several counties.

CURSOR, in mathematical instruments, is any small piece that slides; as the piece in an equinoctial ring-dial that slides to the day of the month. It also signifies a brass point screwed on the beam-compasses, which may be moved along the beam for the striking of circles.

CURTATE *distance*, in astronomy, the distance of a planet from the sun to that point where a perpendicular let fall from the planet meets with the ecliptic.

CURTIN, **Curtain**, or **Courtin**, in fortification, is that part of the rampart of a place which is betwixt the flanks of two bastions bordered with a parapet five feet high, behind which the soldiers stand to fire upon the covered way and into the moat.

CURTISIA, a genus of the tetrandria monogynia class and order. There is one species, a tree of the Cape.

CURVATURE *of a line*, is the peculiar manner of its bending or flexure, by which it becomes a curve of certain peculiar properties.

Of all the circles that touch a curve in any given point, that is said to have the same curvature with it, which touches it so closely, that no circle can be drawn through the point of contact between them: and this circle is called the circle of curvature; its centre, the centre of curvature; and its semi-diameter, the ray of curvature belonging to the point of contact.

CURVE, in geometry, a line which, running on continually in all directions, may be cut by one right line in more points than one.

Curves, *family of*, according to Wolfius, is a congeries of several curves of different kinds, all defined by the same equation of an indeterminate degree; but differently, according to the diversity of their kinds.

CUSCUTA, *dodder*, a genus of the digynia order, in the tetrandria class of plants, and in the natural method ranking under those the order of which is doubtful. There are four species, one of which is a native of Britain, viz. the Europaea, dodder, hell-weed, or devil's-guts. This is a most singular plant, almost destitute of leaves, parasitical, creeping, fixing itself to whatever is next to it. It decays at the root, and afterwards is nourished by the plant which supports it. Hops, flax, and nettles, are its common support, but principally the common nettle.

CUSSONIA, a genus of the pentandria digynia class and order. There are two species, natives of the Cape.

CUSTOM, a very comprehensive term, denoting the manners, ceremonies, and fashions of a people which, having turned into a habit, and passed into use, obtains the force of laws; in which sense it implies such usages as, though voluntary at first, are yet, by practice, become necessary.

Custom is hence, both by lawyers and civilians, defined *lex non scripta*, a law, or right, not written, established by long usage, and the consent of our ancestors: in which sense it stands opposed to the *lex scripta*, or the written law.

CUSTOS, the principal clerk belonging to the court of common pleas, whose business it is to receive and keep all the writs made returnable in that court, filing every return by itself; and, at the end of each term, to receive of the prothonotaries all the records of the nisi prius, called the posteas.

Custos *rotulorum*, an officer who has the custody of the rolls and records of the sessions of peace, and also of the commission of the peace itself. He usually is some person of quality, and always a justice of the peace, of the quorum, in the county where he is appointed.

CUT-*water*, or knee of the head, the sharpness of the head of the ship, below the beak; so called because it cuts or divides the water before it comes to the bow.

CUTICLE, *cuticula*, in anatomy, a thin membrane closely lying upon the skin, or cutis, of which it seems a part, and to which it adheres very firmly, by the intervention of the corpus reticulare.

CUTIS, the skin, in anatomy, is that strong thick covering which envelopes the whole external surface of animals. It is composed chiefly of two parts: a thin white elastic layer on the outside, which is called the epidermis, or cuticle; and a much thicker layer, composed of a great many fibres, closely interwoven, and disposed in different directions; this is called the cutis, or true skin.

CUTTING, in heraldry, is used for the dividing a shield into two equal parts, from right to left, parallel to the horizon, or in the fesse way.

CYANELLA, a genus of the hexandria monogynia class and order. There are three species, natives of Africa.

CYANILE, a stone commonly found in granite rocks. The primitive form of its crystals is a four-sided oblique prism, the sides of which are inclined at an angle of 130°. It is sometimes crystallized in six-sided prisms. It causes single refraction, and its specific gravity is from 3.5. to 3.6. Its colour is white, with shades of sky or Prussian blue.

CYCAS, in botany, a genus of plants belonging to the first natural order, palmae. The fruit is a dry plum with a bivalved kernel. There are two species: 1. The circinalis, or sago-tree, grows spontaneously in the East Indies, and particularly on the coast of Malabar. It runs up with a straight trunk to 40 feet or more. The leaves are pinnated, and grow to the length of seven or eight feet. The flowers are produced in long bunches at the footstalks of the leaves, and are succeeded by oval fruit, about the size of large plums, of a red colour when ripe, and a sweet flavour. Each contains a hard brown nut, inclosing a white meat, which tastes like a chesnut.

This is a valuable tree to the inhabitants of

India, as it not only furnishes a considerable part of their constant bread, but also supplies them with a great article of trade. The Indians saw the body into small pieces, and after beating them in a mortar, pour water upon the mass; this is left for some hours to settle. When fit, it is strained through a cloth; and the finer particles of the mealy substance running through with the water, the gross ones are left behind and thrown away. After the farinaceous part has sufficiently subsided, the water is poured off, and the meal being properly dried, is occasionally made into cakes and baked.

The same meal more finely pulverized, and reduced into granules, is what is called sago, which is sent into all parts of Europe, and sold in the shops as a great strengthener and restorative.

2. The cycas revoluta, or bread-tree of the Hottentots, was discovered by Professor Thunberg. The pith, or medulla, is collected and tied up in skins, and then buried in the earth for several weeks, till it becomes sufficiently mellow and tender to be kneaded up with water into a paste, of which they afterwards make small loaves or cakes, and bake them under the ashes.

CYCLAMEN, *sowbread*, a genus of the monogynia order, in the pentandria class of plants; and in the natural method ranking under the 21st order, preciæ. There are five species, which produce many beautiful varieties. They are low, herbaceous, flowery perennials, of the tuberous-rooted kind, with numerous angular, heart-shaped, spotted, marbled leaves, with flowers, of various colours. All the varieties are extremely ornamented, and some of the flowers very fragrant.

CYCLAS, a genus of the decandria monogynia class and order. There are two species, trees of Guiana.

CYCLE, in chronology, a certain period or series of years, which regularly proceed from the first to the last, and then return again to the first, and circulate perpetually. The most considerable cycles are those of the sun, of the moon, and of the Roman indiction.

CYCLOID. The cycloid is a curve generated by the motion of any point in the periphery of a circle, whilst the periphery itself revolves on a right line, till that point which touched the line at the beginning of the motion be brought to touch it again.

CYCLOPÆDIA, or *Encyclopædia*, denotes the circle or compass of arts and sciences.

CYCLOPTERUS, the sucker, in ichthyology, a genus belonging to the order of amphibia nantes. There are three species:

1. The lumpus, or lump-fish, grows to the length of nineteen inches, and weighs seven pounds. The shape of the body is like that of the bream, deep and very thick, and it swims edge-ways. The back is sharp and elevated; the belly flat, of a bright crimson colour. Along the body are several sharp bony tubercles. Beneath the pectoral fins is an aperture surrounded with a fleshy substance, edged with small threads, by which the animal adheres so closely to the substance it fastens on, as not to be removed but with great trouble. These fish abound in the Greenland seas, and on the coast of Scotland. 2. The liparis, or sea snail, is of a soft unctuous texture, and soon melts away. The length is five inches, and the colour a pale brown. 3. Cyclopterus minor, or the lesser sucking fish, is found on the coast of Britain. It is about four inches, and fastens very tenaciously to stones and rocks.

CYDER. See Cider.

CYGNUS, in astronomy, a constellation of the northern hemisphere, consisting of 17 stars according to Ptolemy's Catalogue; of 19 in Tycho's; and in the Britannic Catalogue of 107.

CYLINDER, in geometry, a solid body, supposed to be generated by the rotation of a parallelogram. See Geometry.

Cylinder, *properties of the.* 1. The section of every cylinder by a plane oblique to its base is an ellipsis. 2. The superficies of a right cylinder is equal to the periphery of the base multiplied into the length of its side. 3. The solidity of a cylinder is equal to the area of its base multiplied into its altitude. 4. Cylinders of the same base, and standing between the same parallels, are equal. 5. Every cylinder is to a spheroid inscribed in it as 3 to 2. 6. If the altitudes of two right cylinders be equal to the diameters of their bases, those cylinders are to one another as the cubes of the diameters of their bases.

CYLISTA, a genus of the class and order diadelphia decandria. There is one species.

CYMATIUM, in architecture, a member or moulding of the cornice, the profile of which is waved, that is, concave at the top, and convex at the bottom.

CYMBACHNE, a genus of the class and order polygamia monœcia. The inflorescence is half-spiked. There is one species, a grass of Bengal.

CYMBAL, or *cymbalum*, a musical instrument of antiquity, similar to the tympanum or drum. The cymbal was round, and made of brass, like our kettle-drums; but is generally thought to have been smaller.

CYMBARIA, a genus of the class and order didynamia angiospermia. The calyx is ten-toothed; capsule cardate, two-celled. There is one species, an herbaceous plant of the mountains of Dauria.

CYMOPHANE, the oriental chrysolite of jewellers. This stone has been found only in Brazil, the island of Ceylon, and at Northschink in Siberia. It is usually met with in round masses about the size of a pea, but it is sometimes crystallized.

CYNANCHUM, *bastard dog's-bane* a genus of the digynia order, in the pentandria class of plants, and in the natural method ranking under the 30th order, contortæ. There are 27 species, of which the following are the most remarkable:

1. The acutum, or Montpelier scammony.

2. The Monspeliacum, or round-leaved Montpelier scammony. They abound with a milky juice like the spurge which, when concreted, has frequently been sold for scammony.

CYNARA, the *artichoke*, a genus of the polygamia æqualis order, in the syngenesia class of plants. Of this genus there are six species, but only two are cultivated for use.

1. The scolymus, or garden artichoke, has large, thick, perennial roots, crowned by a cluster of large, pinnatifid, erect leaves. In

the middle are upright stalks rising a yard high, on the top of which is a large round scaly head, composed of numerous, oval, calycinal scales, inclosing the florets, sitting on a broad fleshy receptacle, which, with the fleshy base of the scales is the only eatable part of the plant. The varieties of this species are, 1. The conical green-headed French artichoke, having the small leaves terminated by spines, the head of a light-green colour, with the scales pointed at top, opening, and turning outward. 2. The globular-headed Dutch artichoke, having leaves without spines, a strong stalk, the head large, globular, a little compressed at top, and of a brown colour; broad obtuse scales emarginated at top, growing close, and turning inward.

2. The cardunculus, or cardoon, greatly resembles the artichoke, but is of larger and more regular growth; the leaves being more upright, taller, broader, and more regularly divided; and the stalks of the leaves blanched are the only eatable parts of the plant.

CYNICS, a sect of ancient philosophers, who valued themselves upon their contempt of riches and state, arts and sciences, and every thing, in short, except virtue or morality.

CYNIPS, in zoology, a genus of insects belonging to the hymenoptera order. The quercus folii, or oak-leafed cynips, is of a shining brown colour. It is in the little, smooth, round, hard galls, found under the oak-leaves, generally fastened to the fibres, that this insect is produced, a single one in each gall.

The quercus gemmæ, or oak-bud cynips, is of a very dark green, slightly gilded. It deposits its eggs in oak-buds, and produces one of the finest galls. There are 19 species of this insect.

CYNOGLOSSUM, hound's-tongue; a genus of the monogynia order, in the pentandria class of plants; and in the natural method ranking under the 41st order, asperifoliæ. There are 12 species, none of them remarkable for their beauty. The root of one of them, the officinale. was formerly, used in medicine, but it is now discarded from practice.

CYNOMETRA, a genus of the monogynia order in the decandria class of plants; and in the natural method ranking with those of which the order is doubtful. There are two species.

CYNOMORIUM, a genus of the monandria order, in the monœcia class of plants; and in the natural method ranking under the 50th order, amentaceæ. There are three species, of no note.

CYNOSORUS, a genus of the digynia order, belonging to the triandria class of plants, and in the natural method ranking under the 4th order, gramina. There are 20 species, four of which are natives of Britain, viz. the cristatus, or crested dog-tail grass; the echinatus, or rough dog-tail grass: the cæruleus, or blue dog-tail grass; and the paniceus, or bearded dog-tail grass.

CYPERUS, a genus of the monogynia order, in the triandria class of plants; and in the natural method ranking under the 3d order, calamariæ. There are 53 species; the only remarkable are the round, the long sweet cyperus, and the papyrus. The former is a native of the East Indies, and grows by the sides of rivulets, ditches, &c.

2. The long-leaved, commonly called English or Flemish cyperus, grows in the water, and along the banks and river sides. The roots of both plants are esteemed cordial and diuretic, and the long cyperus is much used by perfumers and glovers.

3. The papyrus is famous both in ancient and modern history, and a very minute description of it is given by Pliny. It grows in the lakes of Ethiopia and Egypt. It was very early in use as paper, Numa having left a number of books written on papyrus. The paper was made from the pellicle between the pith and the bark.

CYPRÆA, or *gowrie*, in zoology, a genus of insects belonging to the order of vermes testacea. It is an animal of the limax or snail kind.

CYPRESS. See CUPRESSUS.

CYPRINUS, in ichthyology, a genus of fishes belonging to the order of abdominales. There are 31 species, principally distinguished by the number of rays in the vent-fin. The most remarkable are:

1. The carpio, or carp. This fish chiefly abounds in the rivers and lakes of Polish Prussia, where they are sometimes taken of a vast size.

Carp are very long lived. Gesner brings an instance of one that was near 100 years old. They grow also to a very great size. Some authors speak of carp weighing 200 pounds, and being five feet in length. The carp is extremely cunning, and on that account is sometimes styled the river-fox. They are also very shy in taking a bait; yet at the spawning-time they are so simple, as to suffer themselves to be caught, by any body that will attempt it.

In some parts carp are fattened by being kept out of water, and fed with bread soaked in milk; but in this case they require to be very frequently dipped in water, over which they are kept suspended in a net, and wrapped in moss.

2. The barbus, or barbel, is an extremely coarse fish. It is so tame as to suffer itself to be taken by the hand; and people have been known to take numbers by diving for them. The barbel is about the length of three feet, and weighs about 18 pounds; the belly white; the dorsal fin is armed with a remarkably strong spine, with which it can inflict a very severe and dangerous wound on the incautious handler, and even do much damage to nets. The roe is very noxious, affecting those who unwarily eat of it, with a nausea, vomiting, purging, and a slight swelling.

3. The tinea, or tench, is reckoned a wholesome and delicious food in this country; but the Germans are of a different opinion. By way of contempt, they call it the shoe-maker. Gesner even says, that it is insipid and unwholesome. The tench is thick, and short in proportion to its length. The colour of the back is dusky; the dorsal and ventral fins of the same colour; the head, sides, and belly, of a greenish cast, most beautifully mixed with gold.

4. The gobio, or gudgeon, is generally found in gentle streams, and is of a small size, the largest not exceeding ½ pound weight.

5. The brama, or bream, is an inhabitant of lakes, or the deep parts of still rivers. It is a fish that is very little esteemed, being extremely insipid.

6. The rutilus, or roach, is a common fish,

found in still deep rivers. It has never been known to exceed five pounds in weight.

7. The leuciscus, or dace, like the roach, is gregarious, haunts the same place, is a great breeder, very lively, and, during summer, is very fond of frolicking near the surface of the water. It never exceeds the weight of a pound and a half.

8. The cephalus, or chub, is a very coarse fish, and full of bones. It frequents the deep holes of rivers, and in summer commonly lies on the surface beneath the shade of some tree or bush. It feeds on worms, caterpillars, grasshoppers, and other insects that happen to fall into the water; and it will even feed on cray-fish. It will rise to a fly. Some of this kind have been known to weigh eight or nine pounds.

9. The alburnus, or bleak. These fish are very common in many of our rivers, and keep together in large shoals. At certain seasons they seem to be in great agonies; they tumble about near the surface of the water, and are incapable of swimming far from the place; but in about two hours they recover and disappear. This is supposed to be in consequence of their being tormented by a species of hair-worm. The bleak seldom exceeds five or six inches in length. Artificial pearls are made with the scales of this fish; and probably also with those of the dace.

10. The auratus, or golden fish, a small fish, domesticated by the Chinese, and generally kept for ornament by great people in their courts and gardens. They breed them in small ponds made for the purpose, in basons, and even in porcelain vessels. This fish is no larger than our pilchard. They were first introduced into England about the year 1691; but were not generally known till 1728.

CYPRIPEDIUM, *lady's slipper,* a genus of the diandria order, in the gynandria class of plants, and in the natural method ranking under the 5th order, orchideæ. There are five species; of which only one, viz. the calceolous, is a native of Britain. It grows in rough ground in different parts of the island. The other species are natives of America.

CYRILLA, a genus of the class and order didynamia angiospermia. There is one species, a handsome plant of the West Indies.

CYRTANTHUS, a genus of the class and order hexandria monogynia. The corolla is tubular, inserted in the tube. There are two species, bulbs of the Cape.

CYTINUS, a genus of the dodecandria order, in the gynandria class of plants, and in the natural method ranking under the 11th order, sarmentaceæ. There is one species.

CYTISUS, *tree trefoil,* a genus of the decandria order, in the diadelphia class of plants, and in the natural method ranking under the 32d order, papilionaceæ. The calyx is bilabiated, with the upper lip bifid; inferior tridentate; the legumen attenuated at the base. There are eighteen species. All the cytisuses are shrubs without spines, most of them fit for ornamental plantations. They are hardy; the leaves are ternate, and in some the flowers grow in bunches.

D.

D, One of the letters of the alphabet, the fourth in order, and the third consonant. It is formed in the voice, by applying the top of the tongue to the forepart of the palate, and then separating them with a gentle gust of the breath, the lips being at the same time open,

As a numeral D denotes 500; and with a dash over it, thus D denotes [illegible]000. Used in abbreviation, it has various significations; thus, D. stands for doctor, as M. D. doctor of medicine; D. T. doctor of theology; D. D. signifies doctor of divinity; D. D. D, is used for dat, dicat, dedicat; and D. D. D. D. for dignum deo donum dedit.

DACE, a species of Cyprinus.

DACTYL, in ancient poetry, a metrical foot, consisting of one long and two short syllables, as mūrmŭrĕ. The dactyl and spondee are the only feet or measures used in hexameter verses: the former being esteemed more sprightly, and the latter more solemn and grave.

DAFFODIL, the same with the narcissus of botanists.

DAGGYSA, a genus of the vermes class and molusca order, of which there is only a single species. The dagysa inhabits the Spanish sea, is about three inches long, and one inch thick. They adhere to each other by the sides, and so nearly resemble the genus salpha, that they might, with propriety, be incorporated into one.

DAIS, a genus of the monogynia order, in the decandria class of plants, and in the natural method ranking under the 31st order, vepreculæ. There are three species, natives of India and the Cape.

DALBERGIA, a genus of the decandria order, in the diadelphia class of plants. There are two species, trees of Malabar and Surinam.

DALECHAMPIA, a genus of the monadelphia order, in the monœcia class of plants, and in the natural method ranking under the 38th order, tricoccæ. There are two species, of which the scandens is a native of Jamaica. It is a climbing plant, which rises to a considerable height, and is remarkable for having its leaves armed with bristly hairs, which sting the hands of those who touch them.

DAMAGE, generally signifies any hurt or hindrance that a man receives in his estate; but in the plural in common law, is the recompence that is given to a man by a jury as a satisfaction for some injury sustained.

In actions upon the case, the jury may find less damages than the plaintiff lays in his declaration, though they cannot find more.

DAMAGE *faisant,* is where the beasts of another come upon a man's land, and there feed, tread, or spoil his corn or grass there

growing; in which case the owner of the ground may impound them, till satisfaction be made.

DAMASK, a silk stuff, with a raised pattern of dressed silk, both in warp and woof: they are made at Chalons in Champagne, and in some places in Flanders, as at Tournay, &c.

Damask is also a kind of wrought linen made in Flanders and in this country. It takes its name on account of its resemblance to damasks. It is chiefly used for table linen.

Damask is also applied to a very fine steel, in some parts of the Levant, chiefly at Damascus in Syria; whence its name. It is used for sword and cutlas-blades, and is finely tempered.

DAMASKEENING, or **Damasking**, the art or operation of beautifying iron, steel, &c. by making incisions in them, and filling them up with gold and silver wire; chiefly used for adorning sword-blades, locks of pistols, &c.

DAMASONIUM, a genus of the hexandria class and order. The spathe is one leafed; perianthum one-leafed, three-parted; berry ten-celled, inferior, there is one species, a native of India.

DAMPS. The permanently elastic fluids which are extricated in mines, and are destructive to animal life, are called damps by the miners. The chief distinctions made by the miners are, choak-damp, which extinguishes their candles, hovers about the bottom of the mine, and consists for the most part of carbonic acid gas; and fire-damp, or hydrogen gas, which occupies the superior spaces, and does great mischief by exploding whenever it comes in contact with their lights. See Gas, Combustion, and Lamp.

DANCE, or **Dancing**, as at present practised, may be defined, "an agreeable motion of the body, adjusted by art to the measures or time of instruments, or of the voice."

The practice is of very great antiquity, and from its being so common among the most uncivilized and barbarous nations, it appears to have had its origin in the natural disposition of the mind to express its emotions in corresponding gestures of the body. Like every other popular amusement, dancing has its strenuous advocates: but when we consider that its claims are, at best, but of the negative kind, and how largely it is made to minister to licentiousness, both in our own country, and in others, we feel disposed to adopt the opinion of Dr. Gregory, who, in his Encyclopædia, thus defines it: "Dance, *a silly amusement of the idle and thoughtless.*"

DAPHNE, spurge-laurel, a genus of the monogynia order, in the octandria class of plants, and in the natural method ranking under the 31st order, vepreculæ. There is no calyx; the corolla is quadrifid and withering, inclosing the stamina. The fruit is a monospermous berry. There are 28 species: these are shrubs about five feet high. D. Mezereum. Mezereon is a strong woody plant, putting forth branches on every side, so as to form a regular head. The flowers come out very early in the spring, before the leaves, in clusters all round the shoots of the former year. The leaves are smooth and entire, of a pale green colour, about two inches long and three quarters of an inch broad. It is a native of Lapland, Sweden, Denmark, Germany, Switzerland, France, and Great Britain.

DARAPTI, among logicians, one of the modes of syllogisms of the third figure, whose premises are universal affirmatives, and the conclusion is a particular affirmative: thus,

Dar- Every body is divisible:
ap- Every body is a substance;
ti. Therefore some substance is divisible.

DASYPUS, the armadillo, in natural history, a genus of mammalia of the order bruta. Generic character: no tusks; grinders short and cylindrical, and seven or eight in each jaw; body covered with a shelly armour, intersected by circles. These animals chiefly inhabit South America, where they burrow like rabbits in the ground, and live principally upon roots and fruits. They exhibit a singular difference from other quadrupeds, in that testaceous substance which covers them completely, and yet is so admirably adapted to their frame by its minute intersections, as by no means to interfere with flexibility or quick movement. When attacked, they roll themselves up into the compactness of a ball; thus presenting to the enemy almost impenetrable armour. They repose by day, and at night quit their habitations for food. They are perfectly inoffensive. In a state of confinement they will devour with considerable appetite animal food, for which, in a state of nature, they do not appear to have any relish. They drink most copiously, and are often found extremely fat. They are regarded as a very great luxury for the table, and are not unfrequently dug from their burrows to be sold for food; for this purpose, however, they should always be taken young.

Their claws are of uncommon size and strength, and enable them to form their subterraneous habitations with extreme facility. Shaw reports, that the female produces three or four times in a year; and Gmelin states, that she produces every month. It is ascertained, therefore, that they are highly prolific. It is the practice of naturalists to define the different species by the different number of testaceous circles on the body. Gmelin enumerates ten species, and Shaw six. This extraordinary variety among quadrupeds deserves the particular attention of naturalists, who do not appear to have so clearly defined the several species, or to have collected so many particulars of the manners and habits of the animal in general as its most singular structure excites a desire to be informed of.

DATA, among mathematicians, a term for such things or quantities as are given or known, in order to find other things that are unknown. Euclid uses the word data for such spaces lines, and angles, as are given in magnitude, or to which we can assign others equal.

DATE, in law, is the description of the day, month, year of our Lord, and year of the reign of the king, in which a deed or other writing is made.

In writings of importance, the date should be written in words at length. An antedate is a date prior to the real time when the instru-

ment was signed. A post date is that which is posterior to the real time when the instrument was passed.

DATE. See PHŒNIX.

DATISCA, a genus of the dodecandria order, in the diœcia class of plants, and in the natural method ranking under the 54th order, miscellaneæ. There are two species, but not remarkable.

DATISI, in logic, a mode of syllogism in the third figure, in which the major is a universal affirmative, and the minor and conclusion particular affirmative propositions.

DATIVE, among grammarians, the third case in the declension of nouns, expressing the relation of a thing to whose profit or loss some other thing is referred. It is called dative, because usually governed by a verb, implying something to be given to some person. In the English language, this relation is expressed by the signs *to* or *for*.

DATURA, the thorn apple, a genus of the monogynia order, in the pentandria class of plants, and in the natural method ranking under the 28th order, luridæ. There are eight species: the most remarkable are,

1. The stramonium, or common thorn-apple, rises about a yard high, with an erect, strong, hollow, green stalk, branching luxuriantly, having the branches widely extended on every side; large, smooth, dark-green leaves; and from the divisions of the branches, large white flowers singly, succeeded by oval, prickly capsules, growing erect, commonly called thorn-apples. At night the upper leaves rise up and inclose the flowers. The blossoms have sometimes a tinge of purple or violet. An ointment prepared from the leaves gives ease in external inflammations and in the hæmorrhoids.

The seeds were recommended by Dr. Stock to be taken internally in cases of madness: but they seem to be a very unsafe remedy. Taken even in a small dose, they bring on a delirium, and in a large one, would certainly prove fatal. Cows, horses, sheep, and goats, refuse this plant.

2. Datura arborea, is a stove-plant, much esteemed for the beauty and fragrance of its large white flowers.

DAUCUS, the carrot, a genus of the digynia order in the pentandria class of plants, and in the natural method ranking under the 45th order, umbellatæ. There are seven species, but the only one which merits attention is the carota, or common carrot. This is so well known as to need no description. There are several varieties, as the white, the orange, and the purple carrot; but of these the orange carrot is the most esteemed. It grows longer, larger, and is commonly more handsome, than the others, being often 15 or 18 inches long in the eatable part, and from two to four in diameter at top. Carrots are propagated by seeds; which are sown at different seasons of the year, in order to procure a supply of young roots for the table at all times. The season for sowing for the earliest crop is soon after Christmas; the manner of cultivating them is too well known to need any particular description. A rich sandy loam is the best land for carrots, which after the crop is removed, will be in high cultivation for corn.

DAVIT, in a ship, a long beam of timber, used as a crane to hoist the flukes of the anchor to the top of the bow, without injuring the sides of the ship as it ascends; an operation which by mariners is called fishing the anchor.

DAY, signifies that space of time during which it is light; or it is the time between the rising and setting of the sun.

The word day is often taken in a larger sense, so as to include the night also; or to denote the time of a whole apparent revolution of the sun round the earth, in which sense it is called by some a natural day, and by others an artificial one; but to avoid confusion it is usual to call it in the former sense simply the day, and in the latter anychthemron, which implies both day and night, and is divided into 24 parts, called hours.

Different nations begin their day at a different hour: thus the Egyptians began their day at midnight, and in this they have been followed by most European nations.

The Babylonians began their day at sun-rising, reckoning the hour immediately before its rising again the 24th hour of the day, whence the hours reckoned in this way are called the Babylonic.

DAYS *of grace*, in commerce, are a customary number of days allowed for the payment of a bill of exchange, &c. after the same becomes due. Three days of grace are allowed in England. For other countries their number is regulated according to distance.

DEAD-*men's-eyes*, in the sea-language, a kind of blocks with many holes in them, by which the shrowds are fastened to the chains: the crow-feet reeve also through these holes.

DEAD-*reckoning*, in navigation, the calculation made of a ship's place by means of the compass and log; the first serving to point out the course she sails on, and the other the distance run. From these two things given, the navigator making proper allowances for the variation of the compass, lee-way, currents, &c. is enabled, without any observations of the sun or stars, to ascertain the ship's place tolerably well.

DEAD-*rising*, among sailors, that part of a ship which lies aft, between the keel and the floor-timbers, next to the stern-post.

DEAD *ropes*, on board a ship, such ropes as do not run in any block.

DEAD-*water*, at sea, the eddy-water just astern of a ship, so called because it does not pass away so swiftly as the water running by her sides does.

DEAFNESS, the state of a person who wants the sense of hearing; or, the disease of the ear, which prevents its due reception of sounds. Deafness generally arises either from an obstruction or a compression of the auditory nerve; or from some collection of matter in the cavities of the inner ear; or from the auditory passage being stopped up by some hardened excrement; or, lastly, from some excrescence, a swelling of the glands, or some foreign body introduced within it.

DEAL, a thin kind of fir planks, of great use in carpentry: they are formed by sawing the trunk of a tree into a great many longitudinal divisions, of more or less thickness, according to the purposes they are intended to serve

Deals are rendered much harder by throwing them into salt water as soon as they are sawed, keeping them there three or four days, and afterwards drying them in the air or sun; but neither this nor any other method yet known, will preserve them from shrinking. Deals are imported into this country from Christiana, and other parts of Norway; from Dantzic, and various parts of Prussia; from St. Petersburgh, Archangel, Narva, Memel, &c.

DEAN, an ecclesiastical dignitary in cathedral and collegiate churches, and head of the chapter. As there are two foundations of cathedral churches in England, the old and the new, so each has a separate way of creating deans.

Rural deans are those who have no absolute judicial power in themselves, but who have the ordering of ecclesiastical affairs within their deanery by the direction of the bishop or archdeacon.

DEATH. Death is usually defined to be a total stoppage of the circulation of the blood, and a cessation of the animal and vital functions consequent thereon, such as respiration, sensation, &c.

The body, when deprived of life, undergoes a continual change. Its smallest fibres become rigid; its minutest vessels become solid fibres, no longer pervious to the fluids; its greater vessels grow hard and narrow; and every thing becomes contracted, closed, and bound up; whence the [illegible]ness, immobility, and extenuation observable in extreme old age. By such means the offices of the minuter vessels are destroyed; the humours stagnate, harden, and at length coalesce with the solids. The most subtile fluids of the body are thus intercepted and lost, the concoction weakened, and the reparation prevented; the coarser juices alone continue to run through the greater vessels, to the preservation of life after the animal functions are destroyed. At length, by these changes, death becomes inevitable, as the necessary consequence of life Such is the gradual process of nature; but it is rare indeed that life is thus long protracted: or that death succeeds merely from the decays and impairment of old age; the work, in thousands of instances, is cut short by the ravages of disease.

The signs of death are in many cases extremely uncertain; and this ought to operate as a caution against hasty burials, particularly in cases of sudden death, drowning, &c. Between life and death the shade is often so undistinguishable as to defy the powers of art to determine where the one ends and the other begins. Our first associations with the idea of death are all of the disgustful and alarming kind: and they are collected from all quarters, from the sensible pains of every sort, from the imperfection, weakness, loathsomeness, corruption, and disorder, where disease, old age, death, animal or vegetable, prevail, in opposition to the beauty, order, and lustre of life, youth, and health. Such associations are truly painful, and yet they are eminently suited to guard the heedlessness and inexperience of youth, from hurrying them into danger and destruction; and to lead the mind to set a proper value on the present state of existence as being only introductory to the eternal future.

DEATH-*watch*. A small insect which makes a noise resembling the beat of a watch; the vulgar have long taken this as a presage of death in the family where it is heard; an error which cannot be too frequently confuted by facts. The real cause of the ticking noise of this little insect is now well understood. It is described by Mr. Derham and others, to be the signal by which the male invites the female There are two kinds of the death-watch. One is of a brown colour and spotted, having pellucid wings: the other is grey, and resembles a louse when viewed with the naked eye; it is very shy of beating when disturbed.

DEBENTURE, is a certificate delivered at the custom-house, when the exporter of any goods or merchandize has complied with the regulations prescribed by certain acts of parliament, in consequence of which he is entitled to a bounty or drawback on the exportation.

DEBT, a sum due from one person to another, in consequence of work done, goods delivered, or money or other value, for which reimbursement has not been made. The non-payment in these cases is an injury.

DEBT, *National*. See NATIONAL DEBT.

DECAGON, in geometry, a plane figure with ten sides and ten angles; it is called a regular decagon, when all the sides and angles are equal.

DECANDRIA, in the Linnæan system of botany, a class of plants, the great characteristic of which is, that they have hermaphrodite flowers, with ten stamina in each.

DECIDUOUS, an appellation chiefly used in respect to plants: thus the calyx or cup of a flower is said to be deciduous, when it falls along with the flower-petals; and, on the contrary, it is called permanent, when it remains after they are fallen. Again, deciduous leaves are those which fall in autumn; in contradistinction to evergreens.

DECK of a ship, is a planked floor from stem to stern, upon which the guns lie, and where the men walk to and fro. Great ships have three decks, first, second and third, beginning to count from the lowermost. Half-deck reaches from the mainmast to the stern of the ship. Quarter-deck is that aloft the steerage, reaching to the round-house.

DECLARATION, an exposure in writing, of the grief and complaint of the demandant, or plaintiff, against the defendant or tenant, wherein he is supposed to have done some wrong.

DECLARATION *of war*, a public proclamation made by the herald at arms to the members or subjects of a state, declaring them to be at war with any foreign power, and forbidding all and every one to aid or assist the common enemy at their peril.

DECLENSION, in grammar, an inflection of nouns according to their cases, as nominative, genitive, dative, &c. See GRAMMAR.

DECLINATION. See GLOBES, *Use of.*

DECOCTION. The operation of boiling. This term is likewise used to denote the fluid itself, which has been made to take up certain soluble principles by boiling. Thus we say a decoction of the bark, or other parts of vegetables, of flesh, &c.

DECOMPOSITION is now understood to imply the separation of the component parts or principles of bodies from each other.

The decomposition of bodies forms a very large part of chemical science. It seems probable from the operations we are acquainted with, that it seldom takes place but in consequence of some combination or composition having been effected. It would be difficult to point out an instance of the separation of any of the principles of bodies which has been effected, unless in consequence of some new combination. The only exception seems to consist in those separations which are made by heat, and voltaic electricity.

DECOY, in naval affairs, a stratagem employed by a ship of war to betray a vessel of inferior force into an incautious pursuit, till she has drawn her within the range of her cannon, or what is called within gunshot. It is usually performed by painting the stern and sides in such manner as to disguise the ship, and represent her either much smaller and of inferior force, or as a friend to the hostile vessel, which she endeavours to ensnare, by assuming the emblems and ornaments of the nation to which the stranger is supposed to belong.

The term is also used to denote a certain method of catching wild fowl by means of ducks and dogs, which are trained for the purpose. This is chiefly practised in Lincolnshire.

DECREPITATION. The crackling noise which several salts make when suddenly heated, accompanied by a violent exfoliation of their particles. This phenomenon has been ascribed to the "sudden conversion of the water which they contain into steam." But the very example, sulphate of barytes, to which these words are applied, is the strongest evidence of the falseness of the explanation; for absolutely dry sulphate of barytes decrepitates furiously without any possible formation of steam, or any loss of weight. The same thing holds with regard to common salt, calcareous spars, and sulphate of potash, which contain *no water*. In fact, it is the salts which are anhydrous, or destitute of water, which decrepitate most powerfully; those that contain water generally enter into tranquil liquefaction on being heated. Salts decrepitate, for the same reason that glass, quartz, and cast-iron crack, with an explosive force, when very suddenly heated; namely, from the unequal expansion of the laminæ which compose them, in consequence of their being imperfect conductors of heat. The true cleavage of minerals may often be detected in this way, for they fly asunder at their natural fissures.

DEED, is a written contract sealed and delivered. It must be written before the sealing and delivery, otherwise it is no deed; and after it is once formally executed by the parties, nothing can be added or interlined; and therefore, if a deed is sealed and delivered with a blank left for the sum, which the obligee fills up after sealing and delivery, this will make the deed void.

A deed must be made by parties capable of contracting, and upon a good consideration; and the subject must be legally and formally set out.

DEEP *sea-line*, or *dip sea-line*, in the sea-language, a small line to sound with; some a hundred and fifty fathoms long, with a hollow plummet at the head, and tallow put into it, to bring up stones, gravel, sand, shells, and the like from the bottom, in order to know the differences of the ground; which being entered from time to time in their books, by comparing observations they guess by their soundings, &c. what coasts they are on, though they cannot see land.

DEER. See CERVUS.

DEFAMATION, the offence of speaking slanderous words of another; and where any person circulates any report injurious to the credit or character of another, the party injured may bring an action to recover damages proportioned to the injury he has sustained; but it is incumbent upon the party to prove he sustained an injury, to entitle him to damages.

DEFENCE, in fortification, all sorts of works that cover and defend the opposite posts, as flanks, casemates, parapets, and faussebrays. See FORTIFICATION.

DEFICIENT *numbers*, those whose parts or multiples added together, fall short of the integer whereof they are the parts; such is 8, its parts, 1, 2, 4, making only 7.

DEFILE, in fortification, a straight narrow passage, through which a company of horse or foot can pass only in file, by making a small front, so that the enemy may take an opportunity to stop their march, and to charge them with so much the more advantage, as those in the front and rear cannot reciprocally come to the relief of one another.

DEFINITION, in rhetoric, is [illegible]cribed by Cicero, a short comprehensive explanation.

The special rules for a good definition, are these: 1. A definition must be universal, or adequate, that is, it must agree to all the particular species or individuals that are included under the same idea. 2. It must be proper, and peculiar to the thing defined, and agree to that alone. These two rules being observed will always render a definition reciprocal with the thing defined, that is, the definition may be used in the place of the thing defined: or they may be mutually affirmed concerning each other. 3. A definition should be clear and plain; and it is a general rule concerning the definition both of names and things, that no word should be used in either of them which has any difficulty in it. 4. A definition should be short, so that it must have no tautology in it, nor any words superfluous. 5. Neither the thing defined, nor a mere synonymous name should make any part of the definition

DEGLUTITION, in medicine, the act of swallowing the food: performed by means of the tongue driving the aliment into the œsophagus, which, by the contraction of the sphincter, protrudes the contents downwards.

DEGRADED *cross*, in heraldry, a cross divided into steps at each end, diminishing as they ascend towards the centre, called by the French peronnee.

DEGREE, in geometry, a division of a circle, including a three hundred and sixtieth part of its circumference.

Every circle is supposed to be divided into three hundred and sixty parts, called degrees, and each degree divided into sixty other parts, called minutes; each of these minutes being again divided into sixty seconds, each second into thirds, and each third into fourths, and so on. See GEOGRAPHY, MAP, SURVEYING.

DELEGATES, *court of*, is so called, be-

cause the judges thereof are delegated by the King's commission under the great seal, to hear and determine appeals in the three following cases: 1. Where a sentence is given in any ecclesiastical cause by the archbishop or his official. 2. When any sentence is given in any ecclesiastical cause in the places exempt. 3. When a sentence is given in the admiral's court, in suits civil and marine, by order of the civil law.

DELFT *ware*, so called because first made at Delft in Holland, is a kind of pottery of baked earth, covered with an enamel or white glazing, which gives it the appearance of porcelain. The basis of this pottery is clay, mixed with a certain quantity of sand; the vessels are slightly baked, so that they resist a sudden application of heat; and they are, lastly, covered with an enamel or glaze, which is composed of common salt, sand ground fine, and the oxides of lead and of tin. The latter gives a white opaque colour to the mass. The furnace and colours used for painting this ware are the same as those employed for porcelain.

DELIMA, in botany, a genus of plants belonging to the polyandria monogynia class, with an elongated style: it has no flower-petals; the cup consists of five leaves; the fruit is a bivalve capsule, and contains two seeds. There is one species.

DELIQUESCENCE. The spontaneous assumption of the fluid state by certain saline substances when left exposed to the air, in consequence of the water they attract from it.

DELIRIUM, in medicine, the production of ideas not answerable to external causes, from an internal indisposition of the brain, attended with a wrong judgment following from these ideas, and an affection of the mind and motion of the body accordingly: and from these increased through various degrees, either alone or joined together, various kinds of deliria are produced.

DELPHINIUM, *dolphin-flower*, or LARKSPUR, a genus of the trigynia order, in the polyandria class of plants, and in the natural method ranking under the 26th order, multisiliquæ. There are 11 species; four are cultivated in gardens. Two of these are annual, and two perennial: they are herbaceous plants of upright growth, rising from 18 inches to four feet in height, garnished with finely divided leaves, and terminated by long spikes of pentapetalous flowers, of blue, red, white, or violet colours. One annual species, the consolida, is found wild in several parts of Britain, and grows in corn-fields.

DELPHINUS, or *dolphin*, a genus of fishes belonging to the order of cete. There are three species:

1. The delphinus, delphis, or dolphin. The natural shape of the dolphin, is almost straight, the back being slightly incurvated, and the body slender; the nose is long, narrow, and pointed, not much unlike the beak of some birds, for which reason the French call it l'oie-de-mer. It has in all 40 teeth, 21 in the upper jaw and 19 in the lower; placed at small distances from each other; so that when the mouth is shut, the teeth of both jaws lock into one another; the spout-hole is placed in the middle of the head; the tail is semilunar; the skin is smooth, the colour of the back and sides dusky, the belly whitish; it swims with great swiftness, and its prey is fish. It was formerly reckoned a great delicacy. This species of dolphin, however, must not be confounded with that to which seamen give the name; the latter being quite another kind of fish, the coryphæna hippuris of Linnæus, and the dorado of the Portuguese.

2. The phocæna, or porpesse. This species is found in all parts of the British seas; but in greatest numbers at the time when fish of passage appear, such as mackarel, herrings, and salmon, which they pursue up the bays with the same eagerness as a dog does a hare. In some places they almost darken the sea, as they rise above water to take breath: porpesses not only seek for prey near the surface, but often descend to the bottom in search of sand-eels and sea-worms, which they root out of the sand with their noses. Their bodies are very thick towards the head, but grow slender towards the tail. The colour of the porpesse is generally black, and the belly whitish; but they sometimes vary. The porpesse is remarkable for the vast quantity of fat that surrounds the body, which yields a great quantity of excellent oil.

3. The orca, or grampus, is found from the length of 15 feet to that of 25. It is remarkably thick, in proportion to its length; one of 18 feet being in the thickest place 10 feet diameter. It is extremely voracious; and will not even spare the porpesse. It is said to be a great enemy to the whale, upon which it will fasten like a dog on a bull, till the animal roars with pain. The nose is flat, and turns up at the end. There are 30 teeth in each jaw. The spout-hole is in the top of the neck. The colour of the back is black, but on each shoulder is a large white spot; the sides marbled with black and white; the belly of a snowy whiteness. These fishes sometimes appear on our coasts, but are found in much greater numbers off the North Cape in Norway.

4. The leucas, a species called by the Germans and Russians "white fish." The body is oblong, and slender, tapering from the back to the tail. It is quite destitute of the dorsal fin. Its length is from 12 to 18 feet. It is common in all the Arctic seas, and forms an article of commerce, being taken on account of its blubber.

DELPHINUS, in astronomy a constellation of the northern hemisphere.

DEMAIN, or DEMESNE, signifies the king's lands appertaining to him in property. No common person has any demains simply understood, for we have no land (that of the crown only excepted) which is not holden of a superior, as all depends either mediately, or immediately, on the crown.

DEMI-*gorge*. See FORTIFICATION.

DEMI-*lune*. See FORTIFICATION.

DEMISE, is applied to an estate in fee simple, fee tail, or for term of life, and so it is commonly taken in many writs. The king's death is in law termed the demise of the king to his successor.

DEMOCRACY, a term derived from Δημος *people*, and κρατειν to *command or govern*, signifies a popular government, in which the supreme power is lodged in the hands of the people; such were Rome and Athens of old; but modern republics, Basil excepted, come nearer to Aristocracy than democracy.

DEMONSTRATION, in logic, a series of syllogisms, all whose premises are either definitions, self-evident truths, or propositions already established.

DEMONSTRATIVE, in grammar, a term given to such pronouns as serve to indicate or point out a thing. Of this number are *hic, hæc, hoc*, among the Latins; and *this, that, these, those*, in English.

DEMURRAGE, is an allowance made to the master of a ship by the merchants, for being detained in port longer than the time appointed and agreed for his departure. The rate of this allowance is generally settled in the charter party.

DEMURRER, is a kind of pause or stop put to the proceeding of an action upon a point of difficulty, which must be determined by the court before any farther proceedings can be had therein.

DENARIUS, in Roman antiquity, the chief silver coin among the Romans, worth in our money about seven pence three farthings. As a weight, it was the seventh part of a Roman ounce.

DENDRITES, or *Arborizations*. This appellation is given to figures of vegetables which are frequently observed in fossil substances. They are of two kinds; the one superficial, the other internal. The first are chiefly found on the surface of stones, and between the strata and in the fissures of those of a calcareous nature.

Several of these dendrites bear a striking resemblance to the poplar; while others exhibit the straight stem, pyramidal form, and pendant branches of the fir. The superficial dendrites are mostly of a brown, changing gradually to a reddish yellow. The internal dendrites are of a deep black. The most esteemed are those found in agates; and more particularly in the sardonyx, cornelian, and other precious stones brought from the East, and which are commonly denominated Moka stones.

DENEB, an Arabic term, signifying tail, used by astronomers to denote several fixed stars. Thus deneb elecet, signifies the bright star in the lion's tail; deneb adigege, that in the swan's tail, &c.

DENDROMETER, from δενδρον *a tree*, and μετρεω *I measure*, an instrument invented by Messrs. Duncombe and Whittel, for which they obtained a patent, so called from its use in measuring trees. It consists of a semicircle divided into two quadrants, and graduated from the middle; upon the diameter there hangs a plummet for fixing the instrument in a vertical position.

The principal use of this instrument is for measuring the length and diameter of any tree, perpendicular or oblique to an horizontal plane, or in any situation of the plane on which it rests, or of any figure, whether regular or irregular, and also the length and diameter of the boughs, by mere inspection; and the inventors of it have calculated tables, annexed to their account of the instrument itself, by the help of which the quantity of timber in a tree is obtained without calculation, or the use of the sliding rule.

The dendrometer, fitted to a theodolite, may be applied to measuring the heights and distances of objects, accessible or inaccessible, whether situated in planes parallel or oblique to the plane in which the instrument is placed. It may be also used for taking all angles, whether vertical, horizontal, or oblique, in any position of the planes in which they are formed.

DENOMINATOR, in arithmetic, a term used in speaking of fractions. The denominator of a fraction is the number below the line, shewing into how many parts the integer is supposed to be divided. Thus in the fraction $\frac{3}{4}$, the number 4 shews that the integer is divided into four parts. So in the fraction $\frac{a}{b}$, b is the denominator.

DENOMINATOR *of a ratio*, is the quotient arising from the division of the antecedent by the consequent. Thus 8 is the denominator of the ratio 40 : 5, because 40 divided by 5 gives 8 for a quotient. It is also called the exponent of a ratio.

DENSITY *of bodies*, is that property directly opposite to rarity, whereby they contain such a quantity of matter under such a bulk. Accordingly, a body is said to have double or triple the density of another body, when their bulk being equal, the quantity of matter in the one is double or triple the quantity of matter in the other. See GRAVITY.

DENSITY *of the planets*. In homogeneous, unequal, spherical bodies, the gravities on their surfaces are as their diameters when the densities are equal, or the gravities are as the densities when the bulks are equal; therefore, in spheres of unequal magnitude and density, the gravity is in the compound ratio of the diameters and densities, or the densities are as the gravities divided by the diameters. See the Tabular View of the Solar System at the end of the article ASTRONOMY.

DENTALIUM, in natural history a genus of the vermes testacea order. The shell has no hinge, and is formed only of one piece. There are eight species. The name dentalium has been given to this shell, from the great resemblance it has to the dentes canini of quadrupeds.

DENTARIA, *toothwort*, or *tooth-violet*, a genus of the siliquosa order, in the tetradynamia class of plants, and in the natural method ranking under the 39th order siliquosæ. There are four species, hardy perennials; producing annual stalks 12 or 18 inches high, adorned with many-lobed leaves, and spikes of flowers of a red or purple colour.

DENTELLA, a genus of the monogynia order, in the pentandria class of plants. The calyx is a five-parted perianthium, with small subulated leaves; the stamina five short subulated filaments; the antheræ small; the pericarpium a globular bilocular capsule; the seeds egg-shaped, and very numerous. There is one species, a native of New Caledonia.

DEODAND, is where any moveable thing inanimate, or beast animate, moves or causes the death of any human being, by mischance.

DEPARTURE, in navigation, is the easting or westing of a ship in respect of the meridian it departed or sailed from; or it is the difference of longitude, either east or west, between the present meridian the ship is under, and that where the last reckoning or observation was made. This departure, any where but under the equator, must be counted according to the

number of miles in a degree proper to the parallel the ship is under. See NAVIGATION.

DEPOT, any particular place in which military stores are deposited for the use of an army. In a more extensive sense, it means several magazines collected together for that purpose. It also signifies an appropriated fort, or place, for the reception of recruits, or detached parties, belonging to different regiments. The barracks near Maidstone are depots for the British cavalry, and Chatham is allotted to the infantry.

DEPRESSION of the *pole*. In sailing or travelling towards the equator a person is said to depress the pole: because as many degrees as he approaches nearer the equator, so many degrees will the pole be nearer the horizon. This arises from the spherical figure of the earth. When a star is under the horizon, it is termed the depression of that star under the horizon. The altitude or depression of a star is an arch of the vertical intercepted between the horizon and the star.

DEPRESSION, or DIP OF THE VISIBLE HORIZON, denotes its sinking or dipping below the true horizontal plane, by the observer's eye being raised above the surface of the sea; in consequence of which the observed altitude of an object is by so much too great.

The following table shews the depression or dip of the horizon of the sea for different heights of the eye.

Height of the eye.	Dip of the horizon.	Height of the eye.	Dip of the horizon.	Height of the eye.	Dip of the horizon.
Feet.	″	Feet.	′ ″	Feet.	′ ″
1	0 57	13	3 26	26	4 52
2	1 21	14	3 34	28	5 3
3	1 39	15	3 42	30	5 14
4	1 55	16	3 49	35	5 39
5	2 8	17	3 56	40	6 2
6	2 20	18	4 3	45	6 24
7	2 31	19	4 10	50	6 44
8	2 42	20	4 16	60	7 23
9	2 52	21	4 22	70	7 59
10	3 1	22	4 28	80	8 32
11	3 10	23	4 34	90	9 3
12	3 18	24	4 40	100	9 33

DERMESTES, a genus of coleopterous insects. There are thirty species of which the principal are:

1. The lardarius of an oblong form, and a dim-black colour, easily distinguishable by a light brown stripe, that runs transversely almost the anterior half of the elytra. Its larva is oblong, and destroys preparations of animals preserved in collections, and even feeds upon the insects.

2. The domesticus varies in size and colour, some being found of a dark-brown, others lighter. This insect makes in wooden furniture those little round holes that reduce it to powder.

3. The violaceus is a beautiful little insect; its elytra being of a violet-blue colour, and the thorax covered with green hairs; the legs are black. The larva, as well as the perfect insect inhabits the bodies of dead animals.

4. The fumatus is of a light brown colour, except the eyes, which are black. The thorax is margined, and the insect has the whole carriage of a scarabæus.

5. The ferrugineus is the largest of the genus; its colour is a rusty iron, having many black spots upon the elytra, which give the insect a gloomy appearance.

DESCENT, in general, is the tendency of a body from a higher to a lower place; thus all bodies, unless otherwise determined by a force superior to their gravity, descend towards the centre of the earth. See GRAVITY and MECHANICS.

DESCENT, *line of swiftest*, is that which a body, falling by the action of gravity, describes in the shortest time possible, from one given point to another. And this line, it is proved by philosophers, is the arch of a cycloid, when the one point is not perpendicularly over the other.

DESCENT, in law, or hereditary succession, is the title by which a man on the death of his ancestor acquires his estate by right of representation as his heir at law; and an estate so descending to the heir is in law called the inheritance.

DESERTER, in a military sense, a soldier who, by running away from his regiment or company, abandons the service.

A deserter is, by the articles of war, punishable by death, and, after conviction, is hanged at the head of the regiment he formerly belonged to, with his crime written on his breast, and suffered to hang till the army leave that camp, for a terror to others.

DESACHE', in heraldry, is where a beast has its limbs separated from its body, so that they still remain on the escutcheon, with only a small separation from their natural places.

DESIGN, in a general sense, the plan order, representation or construction of a building, book, painting, &c.

In building, the term ichnography may be used, when by design is only meant the plan of a building, or a flat figure drawn on paper: when some side, or face of the building is raised from the ground, we may use the term orthography; and when both front and sides are seen, in perspective, it may be termed scenography.

DESIGN, in manufactories, expresses the figures with which the workman enriches his stuff, or silk, and which he copies after some painter, or eminent draughtsman, as in diaper, damask, flowered silk, tapestry, and the like.

In undertaking of such kinds of figured stuffs, it is necessary, that before the first stroke of the shuttle, the whole design be represented on the threads of the warp; we do not mean in colours, but with a number of little packthreads, which, being disposed so as to raise the threads of the warp, let the workmen see, from time to time, what kind of silk is to be put in the eye of the shuttle, for woof. This method of preparing the work is called reading the design and reading the figure, which is performed in the following manner: A paper is provided, considerably broader than the stuff, and of a length proportionate to what is intended to be represented on it. This they divide lengthwise, by as many black lines as there are intended threads in the warp; and cross these lines, by others drawn breadthwise, which, with the former, make little equal squares; on the paper thus squared, the

draughtsman designs his figures, and heightens them with colours as he sees fit.

Design is also used in painting, for the first idea of a large work, drawn roughly, and in little, with an intention to be executed and finished in large. See **Painting.**

DESIGNING, the art of delineating or drawing the appearance of natural objects, by lines on a plane.

DETACHMENT, in military affairs, a certain number of soldiers drawn out from several regiments or companies equally, to be employed as the general thinks proper, whether on an attack, at a siege, or in parties to scour the country.

DETENTS, in clock-work, are those stops, which, by being lifted up or let down, lock or unlock the clock in striking. See **Horology.**

Detent *wheel*, or **Hoop** *wheel*, in a clock, that wheel which has a hoop almost round it, wherein there is a vacancy at which the clock locks.

DETERGENTS, in pharmacy, such medicines as are not only softening and adhesive, but also, by a peculiar activity, conjoined with a suitable configuration of parts, are apt to abrade, and carry along with them, such particles as they lay hold on in their passage.

DETERMINATE *problem*, in geometry, that which has but one, or at least, a limited number of answers: as the following problem, which has but one solution, viz. To describe an isosceles triangle on a given line, whose angles at the base shall be double that at the vertex. But the following has two solutions, viz. To find an isosceles triangle, whose area and perimeter are given.

DETONATION, in chemistry, the noise and explosion which any substance makes upon the application of fire to it. It is also called fulmination; such are the explosions of gunpowder, of fulminating silver, gold, &c.

DEVOTION. Devotion is a sincere and ardent worship of the Deity. In order to its being acceptable to the Deity, devotion must be accompanied with the most profound humility: equally removed from the gloom of superstition, the narrowness of bigotry and the vulgar rant of enthusiasm. It must have God for its sole subject, and spring from a sense of entire dependence on him, and of indissoluble obligations to him.

DEW. The moisture insensibly deposited from the atmosphere on the surface of the earth. This interesting, and, till very lately, inexplicable natural phenomenon will be found described under the article Meteorology, to which it properly belongs.

DEXTER, in heraldry, an appellation given to whatever belongs to the right side of the shield, or coat of arms: thus we say, bend-dexter, dexter-point, &c.

DIABETES, in physic, an excessive discharge of urine, which comes away crude, and exceeds the quantity of liquids drunk.

DIADELPHIA, in the Linnæan system of botany, a class of plants the seven[illegible]nth in order. See **Botany.**

DIADEM, in antiquity, a head-band, or fillet, worn by kings, as a badge of their royalty. It was made of silk, thread, or wool, and tied round the temples and forehead, the ends being tied behind, and let fall on the neck.

Diadem, in heraldry, is applied to certain circles or rims, serving to inclose the crowns of sovereigns and to bear the globe and cross, of the flower-de-luces for their crest.

DIÆRESIS, in grammar, the division of one syllable into two, which is usually noted by two points over a letter, as aulaï instead of aulæ, dissolüenda for dissolvenda.

DIAGONAL, in geometry, a right line drawn across a quadrilateral figure, from one angle to another, by some called the diameter. It is demonstrable, 1. that every diagonal divides a parallelogram into two equal parts. 2. That two diagonals, drawn in any parallelogram bisect each other. 3. A line passing through the middle point of the diagonal of a parallelogram, divides the figure into two equal parts. 4. That the diagonal of a square is incommensurable with one of its sides. 5. That the sum of the squares of the diagonals of every parallelogram, is equal to the sum of the squares of the four sides.

DIAGRAM, in geometry, a scheme for explaining and demonstrating the properties of any figure, whether triangle, square, circle, &c.

Diagram, among musicians, (from the Greek, the name given by the ancients to the table, or model, representing all the sounds of their system.

DIAL. Dials are of various constructions, some being horizontal, others vertical, and others moveable, so as to apply to any particular latitude at pleasure. The use of a dial is to indicate the hour, which is done by means of a wire, or by a triangular board, &c. placed at right angles to the face or index. This triangular piece is called the stile, or gnomon, and is made to point due north: it should be perfectly vertical, and the dial's face, on which the hours are marked, should be equally divided thereby; the line of 12 being in a true direction with the stile. This line of direction is called the substile; the angle contained between the summit of the stile, and the face of the dial is called the elevation. All which have their planes, or faces parallel with the horizon, are called horizontal dials; those which have perpendicular planes, or faces, are called vertical dials; and such as are neither vertical, nor horizontal, are called reclining dials. When erect dials do not face either the north, or the south, they are called declining dials. A universal dial is one that answers for all latitudes.

The line passing under the centre of the stile longitudinally, and marking the hour of 12, is called the meridian; in declining dials the substile makes an angle with the meridian, in proportion to the deviation from a northerly direction: this angle is the difference of longitude. With respect to the manner of constructing, and of placing these useful instruments, we shall now proceed to give some account.

The following is the most simple dial that can be made. (Fig. 1. Plate X.) Divide a circle into twenty-four equal parts, and draw through the several points of division, rays from the centre. That point which is to be the

north, is to be marked XII., the next on the right XI., and thus as far as V., or IIII.: those on the left of the southern point 12, are to be I., II., III., &c. in regular order down to VIII. In the centre, whence the circle was drawn, fix a pin, equal in length to about a diameter of the circle, and be very careful that it be perfectly upright. Now, placing the dial at such an elevation as may equal the latitude of the place where it is to be used, see that the XIIth hour be on the meridional line. Thus for the latitude of 50, the northerly part XII. would require to be raised 50 degrees from the horizon, so that the face of the dial would stand in the plane of the equator, and cause the shadow of the pin to fall on the index, thus to point out the time of day. This is called the equinoctial dial.

Dialing is frequently performed by the aid of the terrestrial globe; but it is to be observed, that this method is, at best, only an approximation towards accuracy; since globes are seldom constructed with such care as to have all their parts in perfect correspondence with each other; nor are the divisions on the horizon sufficiently minute to give the exact points through which the hour lines are to be drawn. We shall here, however, insert one example, although the practice is by no means recommended.

To construct a horizontal dial by means of a terrestrial globe.

Elevate the pole to the latitude, and turn the globe till any particular meridian, (suppose the first) comes to the north point of the horizon, and the opposite meridian, will cut the horizon in the south. Then, set the hour-index to the uppermost XII on its circle; turn the globe westward till 15 degrees of the equator pass under the brazen meridian, and then the hour index will be at I; and the first meridian will cut the horizon in the number of degrees from the north point, that I is distant from XII. Turn on till fifteen more degrees of the equator pass under the meridian, and the hour-index will be at II. and the first meridian will cut the horizon in the number of degrees that II is distant from XII: and so, by making fifteen degrees of the equator pass under the brazen meridian for every hour, the first meridian of the globe will cut the horizon in the distances of all the hours from XII to VI, or 90 degrees; and then you need go no farther; for the distances of XI, X. IX, VIII, VII, and VI, in the forenoon, are the same from XII, as the distances of I, II, III, IV, V, and VI, in the afternoon:

Thus to make an horizontal dial for the latitude of London, which is about 51 d. 30m. north, elevate the north pole of the globe 51 degrees and a half above the north point of the horizon, and then turn the globe until the first meridian (which is that of London on the English terrestrial globe) cuts the north point of the horizon, and set the hour-index to XII at noon.

Then, turning the globe westward till the index points successively to I, II, III, IV, V, and VI, in the afternoon; or until 15, 30, 45, 60, 75, and 90 degrees of the equator pass under the brazen meridian, you will find that the first meridian of the globe cuts the horizon in the following numbers of degrees from the north towards the east, viz. 11 two thirds, 24 and a quarter 38 one twelfth, 53 and a half, 71 one fifteenth, and 90: the distances of the above hours from XII on the plane of the horizon.

To transfer these, and the rest of the hours, to a horizontal plane, draw the parallel right lines *ac* and *bd* (fig. 2) upon that plane, as far from each other as is equal to the thickness of the gnomon, and the space included between them will be the meridian or twelve-o'clock line on the dial. Cross this meridian at right angles with the six o'clock line *gh*, and setting one foot of your compasses in the intersection *a*, as a centre, describe the quadrant *ge* with any convenient radius or opening of the compasses then setting one foot in the intersection *b* as a centre with the same radius describe the quadrant *fh*, and divide each quadrant into ninety equal parts or degrees.

Because the hour lines are less distant from each other about noon, than in any other part of the dial, it is best to have the centres of these quadrants at a little distance from the centre of the dial-plane, on the side opposite to XII, in order to enlarge the hour-distances thereabout under the same angles on the, plane. Thus, the centre of the plane is at C but the centres of the quadrant are at *a* and *b*.

Lay a ruler over the point *b*; and keeping it there for the centre of all the afternoon hours in the quadrant *fh*; draw the hour-line of 1, through 11 degrees and two-thirds in the quadrant; the hour line of II, through 24 degrees and a quarter, &c. and because the sun rises about four in the morning on the longest days in London, continue the hour-lines of IV, and V, in the afternoon, through the centre *b* to the opposite side of the dial. This done, lay the ruler to the centre *a* of the quadrant *eg*, and through the like divisions or degrees of that quadrant, draw the forenoon hour-lines of XI, X, IX, VIII, and VII; and because the sun sets not before eight in the evening on the longest days, continue the hour-lines of VII and VIII in the forenoon, through the centre *a* to VII and VIII in the afternoon; and all the hour-lines will be finished on this dial.

Lastly, through 51 degrees and a half of either quadrant, and from its centre, draw the right line *ag* for the axis of the gnomon *agi*, and from *g*, let fall the perpendicular *gi*, upon the meridian line *ai*, and there will be a triangle, whose sides are *ag*, *gi*, and *ia*. If a plate similar to this be made as thick as the distance between the lines *ac* and *bd*, and set upright between them, touching at *a* and *b*; its hypothenuse *ag* will be parallel to the axis of the world, when the dial is truly set, and will cast a shadow on the hour of the day.

The trouble of dividing the two quadrants may be saved, by means of a scale with a line of chords upon it: for if we extend the compasses from 0 to 60 degrees of the line of chords; and with that extent, as a radius, describe the two quadrants upon their respective centres, the above distances may be taken with the compasses upon the line, and set off upon the quadrants.

To make an erect dial directly south.

Fig. 3. On the meridionial line *ab*, as it points downwards from the foot, or lowest part of the gnomon, measure off any distance as *ac*, for the size of the dial: at *c* erect the perpendicular *cd*, and make the angle *cad* equal to the elevation of the equator; then make a second

triangle *cde*, the angle at *d* being equal to that at *a*. Through *e* draw *gh* at right angles with *ae*. Carry on *eb* equal to *ed*, and with that distance as a radius, describe the quadrant *ef* from *b* as a centre. Measure off the proper angles from the point *b*, through the several parts of the quadrant, which is divided off into six equal parts; these will fall upon the prolonged line *gh*, and give the points thereon, through which lines being drawn from the centre *a* of the six o'clock line to the hour frame, the places of the several hours will be given. The gnomon is fixed at *a*, equal in length to *cd*, but perpendicular to the face of the dial; some use large angular rods of iron. This kind of dial is often seen on the south sides of country church steeples.

To make an erect dial facing the north, invert the whole of that just described, making the gnomon point upwards instead of downwards, and causing all the lower points to be transferred from left to right, and from right to left. This kind of dial will show the hours before VI. A.M., and after VI. P.M. When such is wanted, the best way is to set up a stout post, with the planes of two dials back to back, they pointing due south and due north, respectively; thus as the pin retires from one, it will set upon the other.

We shall now instruct the reader how to make those scales, which are indispensable towards the attainment of perfection in this pleasing branch of study.

The lines useful in dialing are, 1. a line of chords; 2. a line of latitudes; 3. a line of sines; and 4. a line of hours. They are all derived from the quadrant of a circle, as will be shewn in fig. 4.

Describe a circle and divide it into four equal parts by the lines A B and C D, intersecting in the centre E. Draw the chords A C, C B, B D. Now divide the two segments, or quadrants, A D and C B, each into nine equal parts; either of which contains 10 degrees. Placing one leg of your compasses at B for a centre, draw the several arcs from the quadrant subtended by the chord C B, so that they may fall upon that chord, which being numbered according as the several arcs correspond with the division on the quadrant, will give a line of chords gradually diminishing from B towards C: all the intermediate degrees, or the measures of 10° each, thus obtained, may be removed in the same manner from the quadrant, if it be graduated accordingly.

It will be proper to observe in this place that the chord of 60° is the radius of a circle, whose quadrant is subtended by 90° of the same scale: hence a line of chords is easily made upon any circle, so that any part of that circle may be cut off at pleasure.. This is essential in every branch of mathematics; but in dialing it is indispensable to be known: the reader will have observed, that in forming the horizontal dial, the hour lines are drawn through particular points, so as to make the required angles As he may be at a loss how to effect this on many occasions, we shall give an example in fig. 5, whereby every doubt, or difficulty will be removed.

Let it be required to cut off an angle of 40 degrees from the quadrant, which appertains to a circle for which we have not a line of chords in readiness. On the base line A B measure 60 degrees from any line of chords you may have at hand: it may either exceed, or be less than your base line; we will suppose the former; in this case the base line must be prolonged to the measurement of 60° from your scale, which will carry it on to C. With that 60°, as a radius, and from A, as a centre, describe the quadrant C D, concentric with the quadrant E B, from which you would cut off 40°. Now measure 40 degrees on your line of chords, and, placing one foot of the compasses at C, carry the measurement to F, which will cause the angle F A C to measure 40°, and the line F A will, at C, cut off 40 degrees from the quadrant E B. For an angle does not vary by prolongation; therefore, if the exterior quadrant is cut at 40°, the interior quadrant, being concentric therewith, must correspond with that division.

We now proceed to the opposite quadrant, which is not subtended by a chord, but is divided into nine equal parts, of ten degrees each. Draw from the several points of division on the quadrant eight lines, all parallel with E A, and falling on the radius E D; this gives a line of sines; which is of very extensive use in various branches of mathematics. From A draw eight lines, passing through the several points ascertained on the line of sines, to the quadrant B D: these will cut the chord subtending that quadrant, and give thereon a line of latitudes, of equal length with the line of chords, but very differently divided.

The remaining quadrant C A is to be divided into six equal parts, viz. of 15° each: make the chord C F A, and draw its parallel tangent G H. Through the several points of division on the quadrant, draw lines from the centre E to the line G H, which will then represent a line of hours: one of the extremes will be XII, the other will be VI; the several intermediate places of I, II, III, IV, and V, being ascertained by the various lines proceeding from E.

The 6th figure shews part of a dial, constructed by means of the lines of latitudes and of hours. Having set off the parallels for the substile, and drawn the line of VI o'clock, set off the latitude of your place from A towards B; taking the measurement from the line of latitudes. Then measure the whole extent of your line of hours, and, placing one leg of your compasses at B, let the other fall wherever it may reach on the line C A. Divide the line B C according to the measures on your line of hours; and from A draw lines through the points of division to the hour circle, which will thus be truly intersected at the horal points. We have before stated, that by dividing the quadrant C A. in fig. 4. more minutely, that is, by dividing each of the six portions into four, the halves and quarters of hours may be shewn.

Having already shewn the modes of constructing those dials which are in ordinary use, we must refer the more curious reader to Ferguson's Lectures for a great variety of dials, which could not be introduced into this work without greatly augmenting the volume. He will there find the modes of constructing dials by logarithms, and by trigonometry; together with many items relating to the more abstruse parts of our subject. We shall briefly add, that the following general principle

governs the formation of all dials. Take the words of that great luminary of mechanics, the late James Ferguson, F. R. S.

"If the whole earth were transparent and hollow, like a sphere of glass, and had its equator divided into 24 equal parts, by so many meridian semi-circles, one of them being the geographical meridian of any given place, say London; and if the hours of XII. were marked on the equator, both on that meridian, and on its opposite one, and all the rest of the hours on the rest of the meridians, those meridians would be the hour-circles of London: then if the sphere had an opaque axis, terminating at its poles, the shadow of that axis would fall upon every particular meridian and hour, when the sun came to the plane of the opposite meridian; and would, consequently, shew the time at London, and at all the other places on the meridian of London."

DIALECTICS, in the literary history of the ancients, that branch of logics which taught the rules and modes of reasoning.

DIALLAGE, in mineralogy, called also resplendent hornblende. This stone was called *smaragdite* by Saussure, from its resembling the emerald. It is never crystallized. Its texture is foliated, and it is easily divided into plates. The laminæ are inflexible, and the specific gravity is 3. The colour in some cases is fine green; in others with a grey metallic lustre.

DIALING-*lines* or *scales*, are graduated lines placed on rulers or the edges of quadrants and other instruments, to expedite the construction of dials. These are, 1. A scale of six hours, which is only a double tangent, or two lines of tangents, each of 45°, set together in the middle, and equal to the whole line of sines, with the declination set against the meridian altitudes in the latitude of the place. 2. A line of latitudes, which is fitted to the hour-scale, and is made by this canon; As the radius: to the chord of 90° :: so are the tangents of each respective degree of the line of latitudes: to the tangents of other arcs. And then the natural sines of these arches are the numbers, which taken from a diagonal scale of equal parts, shall graduate the divisions of the line of latitudes to any radius. The lines of hours and latitudes are general, for pricking down all dials with centres.

The other scales are particular, and give the several requisites for all upright declining dials by inspection. They are, 1. A line of chords. 2. A line for the substile's distance from the meridian. 3 A line for the stile's height. 4. A line of the angle of 12 and 6. 5. A line of inclination of meridians.

DIALLING-*sphere*, an instrument made of brass, with several semicircles sliding over each other upon a moveable horizon, serving to demonstrate the nature of spherical triangles, as well as to give the true idea of drawing dials on all sorts of planes.

DIALIUM, a genus of the monogynia order, in the diandria class of plants. The corolla is pentapetalous; no calyx; the stamina at the upper side of the receptacle. There is one species, a tree of the East Indies.

DIAMETER, in geometry, a right line passing through the centre of a circle, and terminated at each side by the circumference, which it divides into two equal parts: hence we have a method of describing a semicircle upon any line, assuming its middle point for the centre. The diameter is the greatest of all chords.

How to find the diameter of shot or shells. For an iron ball, whose diameter is given, supposing a nine-pounder, which is nearly four inches, say the cube root 2.08 (of nine pounds,) is to four inches, as the cube root of the given weight, is to the diameter sought. Or, if 4 be divided by 2.08, the cube root of 9, the quotient 1.923 will be the diameter of a one-pound shot; which being continually multiplied by the cube root of the given weight, gives the diameter required. Or by logarithms much shorter, thus: If the logarithm of 1.923, which is .283979, be constantly added to the third part of the logarithm of the weight, the sum will be the logarithm of the diameter. Suppose a shot to weigh 24 pounds: and the given logarithm .283979 to .460070 the third part of the logarithm 1.3802112 of 24, the sum .7440494 will be the logarithm of the diameter of a shot weighing 24 pounds, which is 5.5468 inches.

If the weight should be expressed by a fraction, the rule is still the same: for instance, the diameter of a 1½ pound ball, or $\frac{3}{2}$, is found by adding the logarithm .2839793 found above, to .0586971 one-third of the logarithm of $\frac{3}{2}$; the sum .3426764 will be the logarithm of the diameter required, *i. e.* 2.2013 inches.

DIAMOND, is a precious stone, which has been known from the remotest ages. When pure, it is perfectly transparent like crystal, but much more brilliant. Its figure varies considerably; but most commonly it is crystallized in the form of a six sided prism, terminated by a six-sided pyramid. It is the hardest of all bodies; the best tempered steel makes no impression on it. Lustre, splendent, and internally perfect adamantine. Cleavage octohedral, or parallel to the sides of an octohedron. Foliated structure. Fragments octohedral or tetrahedral. Semitransparent. Refracts single. Scratches all known minerals. Rather easily frangible. Streak grey. Specific gravity 3.4 to 3.6. It consists of pure carbon, as we shall presently demonstrate. When rubbed, whether in the rough or polished state, it shews positive electricity; whereas rough quartz affords negative. It becomes phosphorescent on exposure to the sun or the electric spark, and shines with a fiery light. In its power of refracting light it is exceeded only by red lead-ore, and orpiment. It reflects all the light falling on its posterior surface at an angle of incidence greater than 24° 13′, whence its great lustre is derived. Artificial gems reflect the half of this light. It occurs in imbedded grains and crystals in a sandstone in Brazil, which rests on chlorite and clay-slate. In India the *diamond bed* of clay is underneath beds of red or bluish-black clay; and also in alluvial tracts both in India and Brazil.

The weight, and consequently the value of diamonds, is estimated in carats, one of which is equal to four grains; and the price of one diamond, compared to that of another of equal colour, transparency, purity, form, &c. is as the squares of the respective weights. The average price of rough diamonds that are worth working, is about L. 2 for the first carat. The value of a cut diamond being equal to that of a rough diamond of double weight, exclusive

of the price of workmanship, the cost of a wrought diamond of

1 carat is		L.8
2 do. is	$2^2 \times$ L.8, $=$	32
3 do. is	$3^2 \times$ L.8, $=$	72
4 do. is	$4^2 \times$ L.8, $=$	128
100 do. is	$100^2 \times$ L.8, $=$	80000.

This rule, however, is not extended to diamonds of more than 20 carats. The larger ones are disposed of at prices inferior to their value by that computation. The snow-white diamond is most highly prized by the jeweller. If transparent and pure, it is said to be of the first water.

DIAMOND, *brilliant*, is that which is cut in faces both at top and bottom; and whose table, or principal face at top, is flat.

DIAMOND, *rose*, is one that is quite flat underneath, with its upper part cut in many little faces, usually triangles, the uppermost of which terminate in a point. In rose-diamonds the depth of the stone from the base to the point must be half the breadth of the diameter of the base of the stone.

The largest diamond ever known in the world is one belonging to the king of Portugal, which was found in Brasil. It is still uncut: and Mr. Magellan informs us, that it was of a larger size: but a piece was cleaved or broken off by the ignorant countryman who chanced to find this great gem, and tried its hardness by the stroke of a large hammer upon the anvil. This prodigious diamond weighs 1680 carats: and though uncut, Mr. Romé de L'isle says that it is valued at 224 millions sterling; which gives the estimation of 79, 36 or about 80 pounds sterling for each carat, viz. for the multiplicand of the square of its whole weight. The famous diamond in the sceptre of the emperor of Russia, weighs 779 carats, and is worth at least 4,854, 728 pounds sterling, although it hardly cost 135,417 guineas. This diamond originally was one of the eyes of a Malabaric idol named Scheringham; and a French grenadier, who had deserted from the Indian service, contrived to become one of the priests of that idol, and by that means to steal it. After passing through several hands, the late Prince Orloff purchased it at Amsterdam in 1766, for his sovereign the empress of Russia. The diamond of the Great Mogul is cut in rose, weighs 279 $\frac{9}{16}$ carats, and is worth 380,000 guineas, though it has a small flaw near the bottom.

DIAMOND, in the glass trade, an instrument used for squaring the large plates or pieces; and, among glaziers, for cutting their glass. The diamonds are differently managed. That used for large pieces, as looking glasses, is set in an iron ferule, about two inches long, and a quarter of an inch in diameter; the cavity of the ferule being filled up with lead, to keep the diamond firm. there is also a handle of box or ebony fitted to the ferule, by which it is held.

DIANDRIA, the name of the second class in Linnæus's sexual system, consisting of hermaphrodite plants, which have flowers with two stamina or male organs. The orders in this class are three, derived from the number of styles or female parts. Most plants with two stamina have one style, as jessamine, lilac, privet, veronica, and bastard alaternus: vernal grass has two styles · pepper, three.

DIANTHERA, in botany, a genus of the monogynia order, in the diandria class of plants, and in the natural method ranking under the 40th order, personatæ. The corolla is ringent; the capsule bilocular, parting with a spring at the heel; the stamina each furnished with two antheræ, placed alternately. There are 12 species.

DIANTHUS, clove-gilliflower, carnation, pink, sweet-william, &c. a genus of the digynia order, in the decandria class of plants, and in the natural method ranking under the 22d order, caryophyllei. The calyx is cylindrical and monophyllous, with four scales at the base. There are five petals, with narrow heels; the capsule is cylindrical and unilocular. There are 30 species; but not more than four that have any considerable beauty as garden-flowers, each of which furnishes some beautiful varieties. Most of them are hardy, and perennial or biennial; some of the smaller wild sorts only are annual; stalks annual, from one to three feet in height; leaves opposite, narrow, entire; flowers terminating, many aggregate, some solitary, or several together, but distinct. This numerous genus includes the sweet-williams, carnations, and pinks, with their several varieties; for a full and complete account of which the reader is referred to Martyn's edition of Millar's botany.

DIAPASON, in music. By this term the ancient Greeks expressed the interval of the octave; and certain musical instrument-makers have a kind of rule or scale, called the diapason, by which they determine the measures of the pipes, or other parts of their instruments.

DIAPASON *diapente*, the interval compounded of an octave and a fifth conjoined; a twelfth.

DIAPASON *diatessaron*, the interval compounded of an octave and a fourth conjoined; an eleventh.

DIAPENSIA, in botany, a genus of the petandria-monogynia class of plants, the flower of which consists of one saucer-like petal, the tube being cylindrical, and the limb divided into five obtuse and plane segments; the fruit is a trilocular roundish capsule, containing a great many roundish seeds. There is one species.

DIAPHRAGM, in anatomy, a large robust, musculous membrane or skin, placed transversely in the trunk, and dividing the thorax from the abdomen, whence the Latin writers call it septum transversum.

DIARRHŒA, in medicine, is a disorder which consists of frequent evacuations by stool, and is often occasioned by a stoppage of perspiration, a cold in the feet, acrid substances in the stomach, &c.

DIASTOLE, among physicians, signifies the dilatation of the heart, auricles, and arteries; and stands opposed to the systole, or contraction of the same parts.

DIASTOLE, in grammar, a figure of prosody, whereby a syllable naturally short is made long: such is the first syllable of Priamides in the following verse of Virgil.

Atque hic Priamides: nihil o tibi, amice,
relictum.

DIATESSARON, among ancient musicians, a concord or harmonical interval, composed of a greater tone, a less tone, and one greater

semi-tone: its proportion in numbers is as 4 : 3. The word diatessaron has been of late used by several authors for a harmony of the four gospels.

DICERA, a genus of the polyandria monogynia class and order. The petals are four, ovate and trifid; nectarium four or five emarginate corpuscules; anthers two horned. There are two species, trees of New Zealand.

DICHONDRIA, a genus of the class and order pentandria digynia. The calyx is five-leaved; corolla rotate, inferior; capsule dicoccous. There is one species, a herb of New Zealand.

DICKSONIA, a genus of the class and order cryptogamia filices. There are two species, one of which is supposed to be the same with the baromets or Scythian lamb.

DICTAMNUS, white dittany, or fraxinella, a genus of the monogynia order, in the decandria class of plants, and in the natural method ranking under the 26th order, multisiliquæ. The calyx is pentaphyllous; the petals are five and patulous; the filaments sprinkled with glandulous points; the capsules five, coalited. There are two species.

The dalbus, or fraxinella, has thick, penetrating, perennial roots, collected into a head at top, sending up erect stalks annually, two or three feet high, garnished with pinnated alternate leaves, of three or four pair of oblong stiff lobes, terminated by an odd one; and the stalks crowned by long, pyramidal, loose spikes of flowers, of white, red, and purple colours.

DICTIONARY, a collection, or catalogue, of all the words of a language, art, science, &c. with their explanations, ranged in alphabetical order.

DIDELPHIS, *opossum*, a genus of quadrupeds of the order of feræ. The generic character is: front teeth small, rounded, superior ten, the two middle ones longer; inferior eight, the two middle ones broader and very short; canine teeth long; grinders denticulated; tongue ciliated with papillæ; abdominal pouch, in most species, containing the teats.

These animals first became known to Europeans on the discovery of America, and excited their particular attention by a deviation in their structure from that of all other known quadrupeds. This singularity consisted in the female's possessing a bag or pouch in the lower part of the abdomen, which is opened and closed at pleasure, and to which her young resort for security in danger. Some females possess, according to Gmelin, two or three of these pouches, and the male is stated also occasionally to have one. These animals live in the woods, burrowing in the earth, and, by means of a prehensile tail, are alert in climbing trees. Their general motion is slow, and their food consists of insects, worms, and vegetables, young birds, and particularly poultry. They are by no means peculiar to the Western continent, but are to be found in various other parts of the world. According to both Shaw and Gmelin there are twenty-one species, of which the following are most deserving of attention.

1. *Didelphis Virginiana*, the Virginian opossum. The size of this animal is little inferior to that of the domestic cat; its tail is covered with a scaly skin, the divisions of which give it the resemblance of a small snake, and the animal has the faculty of coiling it round any object, and of thus increasing its means of defence and attack, and its facility of movement among the branches of trees. The teats of the female are inclosed in that astonishing receptacle which distinguishes almost every species of this animal; and immediately after their birth, the young are introduced by their parent to that cavity, or resort to it from an impulse of their own. In some species this cavity does not exist, and nature has substituted for it a sort of furrow. The Virginian opossum is gentle and inoffensive in its manners, but has a rank and disagreeable smell. The female produces four or five at a birth, and prepares a sort of nest for herself, of grass, near the root of a tree. She has the power of closing her pouch, and preserving it closed so completely as to render it a matter of great difficulty to open it. 2. *Didelphis marsupialis*, the Amboyna opossum, is found in the warmer climates of South America, as well as in some countries of the East. It is bred with rabbits in India, and passes, indeed, under the name of the Aroe rabbit. It is not only considered as fit for food, but regarded as a delicacy. This species is much larger than the last. 3. *Didelphis lemurina*, or the New Holland bear. The length of this animal's body is about a foot and a half, and that of its tail about a foot. It is, perhaps, the most elegant species of the genus. It has repeatedly been brought living to England. In its manners, or mode of subsistence, it resembles the other species; it is frequently perceived, however, to sit like a squirrel with its body erect, and holding its food in its hands. Its fur is extremely rich, soft, and thick. 4. *Didelphis petaurus*, or the great flying opossum of New Holland, is nearly two feet in length to the beginning of its tail, which is nearly two feet more. By an expansile membrane reaching on each side of its body, from the fore to the hind legs, it is enabled to leap to an extraordinary distance, and has thus gained the designation by which it is distinguished. Its fur is of the most exquisite fineness, and, for the greater part, of a sable or deep-grey brown colour, extremely brilliant. 5. *Didelphis sciurea*, or the squirrel opossum. This and the last species are considered by Shaw as the two most beautiful quadrupeds in New South Wales. Its general appearance extremely resembles that of a squirrel. Its fur is more soft and valuable than that of the flying opossum. Its abdominal pouch is rather beyond the usual proportion. This animal reposes by day, but during the night ranges in full activity.

DIDELTA, a genus of the class and order syngenesia polygamia frustranea. The calyx is expanding; receptacle honey-combed into parts, which retain the seeds; down, chaffy, many-leaved. There are two species, annuals of the Cape.

DIDUS, or *Dodo*, in ornithology, a genus belonging to the order of gallinæ. The bill is contracted in the middle by two transverse rugæ; each mandible is inflected at the point; and the face is bare behind the eyes. Only one species, the ineptus, is mentioned by Linnæus. Other naturalists have added two more

1. The dronte, or hooded dodo (ineptus, Lin.) is somewhat larger than a swan, and nearly three feet in length. The bill is strong,

large, and hooked at the end; the colour is a pale blue, except the end of the upper mandible, which is yellowish, and has a red spot on the bend of it; the end of the lower is blackish; the irides are white. The general colour of the plumage is cinereous. The head is large, and seems covered with a black hood or cowl. The wings are short, and of a yellowish ash-colour; the tail feathers are curled, stand up on the rump, and incline to yellow. The legs have four toes, three before and one behind. It inhabits the islands of Mauritius and Bourbon in the Indian ocean.

2. The soltaire, or solitary dodo, is a large bird, and the male is said to weigh sometimes 45 pounds. The neck is of a proportionable length and the eye black and lively; the head is not crested, and the general colour of the plumage is grey mixed with brown: it has scarcely any tail, and the bastard wing swells out into a round knob; the wings are too short for flight; and the hind parts are rounded like a horse's rump, being clothed with feathers, which may be termed coverts. According to Leguat, the bird has altogether a noble and elegant gait. This is an inhabitant of the isle of Rodrigue, where it is not uncommon. It makes its nest in by-places, of leaves of the palm, a foot and a half in thickness, and lays one egg. The male sits in his turn, and does not suffer any bird to approach within 200 yards of the spot while the hen is sitting, which is seven weeks.

3. The Nazarene dodo is larger than a swan. The bill is a little bent downwards, and large: instead of feathers, the whole is covered over with a black down: but the wings are feathered, and it has some frizzled ones upon the rump, which serve instead of a tail; the legs are long and scaly, and there are three toes on each foot. This was met with in the isle of France, and described as above by Fr. Cauche: who adds, that the female lays only one egg, which is white, and very large, and that there is always found with it a white stone generally about the size of a hen's egg; that it makes a nest of leaves and dry herbs in the forests on the ground; and that there is likewise found a grey stone in the gizzard of the young bird.

DIDYNAMIA, the name of the 14th class in Linnæus's sexual method, consisting of plants with hermaphrodite flowers, which have four stamina or male organs, two of which are long and two short. See Botany.

DIFFERENCES, in heraldry, certain additaments to coat armour, whereby something is added or altered to distinguish younger families from the elder.

DIFFERENTIAL *calculus*. See Calculus differentialis.

DIGESTER. The digester is an instrument invented by Mr. Papin about the beginning of the last century. It is a strong vessel of copper or iron, with a cover adapted to screw on with pieces of felt or paper interposed. A valve with a small aperture is made in the cover, the stopper of which valve may be more or less loaded, either by actual weights, or by pressure from an apparatus on the principle of the steelyard.

The purpose of this vessel is to prevent the loss of heat by evaporation The solvent power of water when heated in this vessel is greatly increased.

DIGESTION, in animal economy. An important distinction exists between animals and vegetables, in the mode in which they receive their nourishment. Vegetables are constantly absorbing matter from the soil; it immediately passes into the sap vessels, and is soon changed by respiration and secretion. Animals, on the contrary, with very few exceptions, take in food at intervals, and retain it in their stomach for a considerable time, where it undergoes a chemical change, which constitutes the function of digestion, the first step in the general process by which animal matter is formed.

Digestion, in chemistry, an effect produced by the continued soaking of a solid substance in a liquid, with the application of heat.

DIGIT, digitus, in astronomy, the twelfth part of the diameter of the sun or moon, is used to express the quantity of an eclipse. Thus an eclipse is said to be of six digits, when six of these parts are laid.

Digit is also a measure taken from the breadth of the finger. It is properly three-fourths of an inch, and contains the measure of four barley corns laid breadth-wise.

Digits, in arithmetic, signify any integer under 10, as 1, 2, 3, 4, 5, 6, 7, 8, 9.

DIGITALIS, fox-glove, a genus of the angiospermia order, in the didynamia class of plants and in the natural method ranking under the 28th order, Luridæ. There are 12 species; 5 of which are hardy, herbaceous, biennial, and perennial plants. The herbaceous species rise two or three feet high, crowned with spikes of yellow iron-coloured or purple flowers. The canoriensis or shrubby sort rises five or six feet high, having spear-shaped rough leaves, the branches being terminated with flowers growing in loose spikes. All the species are easily raised by seeds. An ointment made of the flowers of purple fox-glove and fresh butter, is much commended for scrophulous ulcers. Taken internally, this plant is a violent purgative and emetic: and is therefore only to be administered to robust constitutions. An infusion of two drams of the leaf in a pint of water, given in half-ounce doses every two hours, till it begins to vomit or purge, is recommended in dropsy, particularly that of the breast.

DIGITATED, among botanists, an appellation given to compound leaves, each of which is composed of a number of simple foliola, placed regularly on a common petiole.

DIGYNIA, from δις *twice*, and γυνη *a woman*, the name of an order or secondary division, in each of the first 13 classes except the 9th, in Linnæus's sexual method; consisting of plants, which to the classic character whatever it is, add the circumstance of having two styles or female organs.

DILAPIDATION, is where an incumbent of a church-living suffers the parsonage house or out-houses to fall down, or be in decay, for want of necessary reparations; or it is the pulling down or destroying any of the houses or buildings belonging to a spiritual living.

DILATRIS, in botany, a genus of the mo-

gynia order, belonging to the triandria class of plants. There is no calyx; the corolla has six petals, and is shaggy; the stigma is simple. Three species, herbaceous plants of the Cape.

DILEMMA, in logic, an argument consisting of two or more propositions, which divides the whole into all its parts, or members, by a disjunctive proposition, and then infers something concerning each part, which is finally referred to concerning the whole.

DILLENIA, in botany, a genus of the polyandria-polygynia class of plants; the corolla which consists of five coriaceous, large, roundish, and hollow petals: the fruit is roundish, and covered with a number of capsules, which are oblong, and divided by a furrow; within, there is a large column or pulpous receptacle: the seeds are numerous, and small. There are seven species, beautiful trees of the East Indies.

DIMENSION, in geometry, is either length, breadth, or thickness; hence a line has one dimension, viz. length; a superficies, two, viz. length and breadth; and a body or solid has three, viz. length, breadth, and thickness.

Dimension is used with regard to the power of the roots of an equation, which are called the dimensions of that root.

DIMINUTION, in architecture, a contraction of the upper part of a column, by which its diameter is made less than that of the lower part.

Diminution in law, is where the pl[illegible] or defendant in a writ of error, alleges on an appeal to a superior court, that part of the record is omitted, and remains in the inferior court not certified; whereon he prays that it may be certified by certiorari.

Diminution, in music, is when there are several words which are to make tones, and several quick motions in a cadence, several quavers, semiquavers, &c. corresponding to a crochet or minim, as when a semibreve is divided into two minims, four crochets, &c.

Diminution, in rhetoric, the exaggerating what you have to say by an expression that seems to diminish it.

DIMINUTIVE, in grammar, a word formed from some other, to soften or diminish the force of it, or to signify a thing is little in its kind. Thus cellule is a diminutive of cell, globule of globe, hillock of hill.

DIMISSORY *letters*, are such as are used where a candidate for holy orders has a title in one diocese, and is to be ordained in another.

DIODIA, in botany, a genus of the monogynia order, in the tetrandria class of plants; and in the natural method ranking under the 47th order, stellatæ. The corolla is monopetalous and funnel-shaped; the capsule bilocular and dispermous. There are six species.

DIODON, or sun-fish, a genus of fishes belonging to the order of amphibia nantes.

There are three species. 1. The atinga, grows to a great bulk; one examined by Sylvianus was above 100 pounds in weight; and Dr. Borlase mentions another taken at Plymouth, that weighed 500 pounds. In form it resembles a bream or some deep fish cut off in the middle. The mouth is very small, and contains in each jaw two broad teeth with sharp edges. The eyes are little, and the pectoral fins are very small, and placed behind them. The colour of the back is dusky and dappled; the belly silvery: between the eyes and the pectoral fins are certain streaks pointing downwards. The skin is free from scales. When boiled, it has been observed to turn into a glutinous jelly, resembling boiled starch when cold, and serving the purposes of glue on being tried on paper and leather. The meat of this fish is uncommonly rank: it feeds on shell-fish. 2. The mola, or short sun-fish, differs from the former, in being much shorter and deeper. The back and the anal fins are higher, and the aperture to the gills not semilunar, but oval. The situation of the fins is the same in both; they are taken on the western coasts of this kingdom. 3. The hystryx, or globe, is common to Europe and South Carolina. As yet only a single specimen has been discovered in our seas, taken at Penzance in Cornwall. The length was one foot seven; the length of the belly, when distended, one foot; the whole circumference in that situation two feet six. The form of the body is usually oblong; but when alarmed, it has the power of inflating its belly to a globular shape of great size. The belly and sides are white, shagreened or wrinkled: and beset with innumerable sharp spines, adhering to the skin by four processes.

DIŒCIA, two houses. The name of the 22d class in Linnæus's sexual method: consisting of plants which, having no hermaphrodite flowers, produce male and female flowers on separate roots. These latter only ripen seeds; but require for that purpose, according to the sexualists, the vicinity of a male plant; or the aspersion of the male dust. See Botany.

DIOMEDIA, in ornithology, the albatross, a genus belonging to the order of anseres. The bill is straight; the superior mandible is crooked at the point, and the lower one is truncated; the nostrils are oval, open, a little prominent, and placed on the sides. There are two species, viz. 1. The exulans, has pinnated wings, and three toes on each foot. It is the albatross of Edwards; is about the size of a pelican. These birds are found in the ocean betwixt the tropics and at the Cape of Good Hope. They are also often seen in vast flocks at Kamtschatka and the adjacent islands, about the end of June, where they are called great gulls. They are voracious birds, and will often swallow a salmon of four or five pounds weight; but as they cannot take the whole of it into the stomach at once, part of the tail-end will often remain out of the mouth; and the natives, finding the bird in this situation, make no difficult matter of knocking it on the head. Their nests are made on the ground with earth, are round in shape, a foot in height, and indented at top. The egg is larger than that of a goose, and is thought to be good food, the white never growing hard with boiling. While the female is sitting, the male is constantly on the wing and supplies her with food. 2. The demersa, has no quill-feathers on the wings; and the feet have four toes, connected together by a membrane. It is the black penguin of Edwards, about the size of a goose, and is found at the Cape of Good Hope. It is an excellent swim-

mer and diver; but hops and flutters in a strange awkward manner on the land, and if hurried, stumbles perpetually. It is said to climb some way up the rocks in order to make its nest; in doing which, it has been observed to assist with its bill. The eggs are two in number, white, as large as those of a duck.

DIONÆA *muscipula*, or Venus's fly-trap, in botany, a newly discovered sensitive plant, in the construction of which nature seems to have had some view towards its nourishment, in forming the upper joint of its leaf like a machine to catch food; and placing upon the middle of it the bait for the unhappy insect that becomes its prey. There is but one species, which is a native of North Carolina, and is found growing in swampy places.

DIOPHANTINE *problems*, in mathematics, certain questions relating to square and cube numbers, and right-angled triangles, &c. the nature of which was determined by Diophantus, of Alexandria, who lived about the third century. In these questions it is endeavoured to find commensurable numbers to answer indeterminate problems; which bring out an infinite number of incommensurable quantities. For example, it is proposed to find a right angled triangle, whose sides x, y, z, are expressed by commensurable numbers; it is known that $x^2+y^2=z$, z being the supposed hypothenuse. But it is possible to assume x and y so, that z will be incommensurable; for if $x=1$, and $y=2$. $z=\sqrt{5}$. The art of resolving such problems consists in managing the unknown quantity or quantities in such a manner, that the square or higher power may vanish out of the equation, and then by means of the unknown quantity in its first dimension, the equation may be resolved without having recourse to incommensurables.

For example, in the equation above, $x^2+y^2=z^2$, suppose $z=x+u$, then is $x^2+y^2=x^2+2xu+u^2$, out of which equation x^2 vanishes, and then it is $y^2=2xu+u^2$, which gives $x=\frac{y^2-u^2}{2u}$. Hence, assuming y and u equal to any numbers at pleasure, the three sides of the triangle will be y, $\frac{y^2-u^2}{2u}$, and $\frac{y^2+u^2}{2u}$, which are all rational whenever y and u are rational. For example, if $y=3$, and $u=1$, then $\frac{y^2-u^2}{2u}=4$, and $x+u$, or $\frac{y^2+u^2}{2u}$, $=5$. This problem admits of very numerous solutions.

DIOPSIS, a genus of the vermes class and of the diptera order. Head with two inarticulate filiform horns much longer than the head, at the tip of which are placed the eyes. It inhabits South America and Guinea, and resembles the ichneumon. There is but a single species.

DIOPTRICS, the science of refractive vision; or that part of optics which considers the different refractions of light in its passing through different mediums, as air, water, glass, &c. and especially lenses. See OPTICS.

DIOSCOREA in botany, a genus of the hexandria order, in the diœcia class of plants; and in the natural method ranking under the 11th order, sarmentaceæ. There are 15 species, of which the only remarkable one is the sativa or yam. The roots are eaten by the inhabitants of both the Indies; and are particularly serviceable in the West India islands, where they make the greatest part of the food *of the negroes. The plant is supposed to have been brought from the East to the West Indies;* for it has never been observed to grow wild in any part of America; but in the island of Ceylon, and on the coast of Malabar, it grows in the woods. The skin of the roots is pretty thick, rough, unequal, covered with many stringy fibres or filaments, and of a violet colour. The inside is white, and of the consistence of red beet. It resembles the potatoe in its mealiness, but is of a closer texture. When raw, the yams are viscous and clammy: when roasted or boiled, they afford very nourishing food; and are often preferred to bread by the inhabitants of the West Indies. The root commonly weighs two or three pounds, though some yams have weighed upwards of twenty pounds.

DIOSMA, AFRICAN SPIRÆA, a genus of the monogynia order, in the pentandria class of plants; and in the natural method ranking with those of which the order is doubtful. There are 19 species; of which the most remarkable are the hirsuta, with narrow hairy leaves; and the oppostifolia, with leaves placed in the form of a cross. The first is a very handsome shrub, growing to the height of five or six feet: the stalks are of a fine coral colour. the leaves come out alternately on every side of the branches, and the flowers are produced in small clusters at the end of the shoots, and are of a white colour. They are succeeded by starry seed-vessels having five corners; in each of which corners is a cell, containing one oblong, black seed: these seed-vessels abound with a resin which emits a grateful scent, as does also the whole plant. The second species rises to the height of three or four feet: the branches are slender, and produced from the stem very irregularly; the leaves are placed cross-wise; the flowers are produced at the ends of the branches, between the leaves: the plants continue a long time in flower, and make a fine appearance when intermixed with other exotics in the open air.

DIOSPYROS, the INDIAN DATE-PLUM; a genus of the diœcia order, in the polygamia class of plants; and in the natural method ranking under the 18th order, bicornes. There are 9 species; the most remarkable are: 1. The lotus, which is supposed to be a native of Africa, whence it was transplanted into Italy, and the south of France. In the warm parts of Europe, this tree grows to the height of 30 feet. This tree produces plenty of fruit every year; from the seeds of which many plants have been raised. 2. The Virginiana, pinshamin, persimon, or pitchumon plum, is a native of America, but particularly of Virginia and Carolina. The seeds of this sort have been frequently imported into Britain, and the trees are common in many nurseries about London. It rises to the height of 12 or 14 feet; but generally divides into many irregular trunks near the ground. In America the inhabitants preserve the fruit till it is rotten, as is practised with medlars in England; when it is esteemed very pleasant.

DIP, of the horizon, is an allowance made in all astronomical observations of altitude for the height of the eye above the level of the sea.

DIPHTHONG, in grammar, a double vowel, or the mixture of two vowels pronounced together, so as to make one syllable.

DIPHYSA, a genus of the class and order diadelphia decandria. The calyx is half five-cleft; legume with a bladder on each side; seeds hooked. There is one species, a small tree of New Spain.

DIPLOMA, an instrument or licence given by colleges, societies, &c. to a clergyman to exercise the ministerial function, or to a physician to practise the profession, &c. after passing examination, or admitting him to a degree.

DIPPING *needle*. See MAGNETISM and NAVIGATION.

DIPSACUS, TEAZEL, a genus of the monogynia order, in the tetrandria class of plants; and in the natural method ranking under the 48th order, aggregate. The common calyx is polyphyllous, proper above; the receptacle paleaceous. There are four species; the most remarkable of which is the dipsacus fullonum, which grows wild in many parts of England. It is much used in raising the nap upon woollen cloth. For this purpose, the heads are fixed round the circumference of a large broad wheel, which is made to turn round, and the cloth is held against them. In the west of England, great quantities of this plant are cultivated for the use just mentioned.

DIPTERA, in natural history, an order of insects in the Linnæan system. This order contains such insects as are furnished with two wings only; such as flies, gnats, and a variety of other insects. Under each wing is a clavate poiser or balancer, with its appropriate scale.

DIPUS, JERBOA, a genus of quadrupeds of the glires order. The generic character is, front-teeth two above and below: fore-legs very short; hind-legs very long: clavicles in the skeleton.

1. Dipus sagitta, or common jerboa. It is about the size of a rat, and is of a pale tawny-brown above, and white beneath; and across the upper part of the rump runs a dusky band. The head is short; the ears thin, broad, upright, and rounded: the eyes large, round, and dark; the fore-legs about an inch long, with five toes to each foot; the hind-legs are extremely long, thin, sparingly covered with short hair, and very much resemble those of a bird: the hind feet have three toes each, the middle longer than the rest, and all are furnished with sharp claws: there is also a very small spur or back toe, with its corresponding claw.

The usual length of the common jerboa, from nose to tail, is about seven inches and a quarter: the tail is about ten inches long, terminated by a flattish tuft of black hair, with a white tip. On each side the nose are situated several very long hairs or whiskers. In its attitudes and manner of progression this animal resembles a bird: generally standing, like the kangaroo, on its hind feet, and leaping to a great distance. It principally uses the fore-legs in feeding; pulling to its mouth the ears of corn, and various other vegetable substances on which it feeds. It inhabits subterraneous holes, which it either prepares itself, or finds ready excavated, in the dry, stony, and sandy deserts in which it resides. During the day it commonly remains in its hole; coming out at night for food and exercise. On the approach of cold it is said to grow torpid for some time, reviving on the change of weather.

2. Dipus jaculus, or alagtaga, in its general appearance perfectly resembles the common or Egyptian jerboa, but is considerably larger. It is principally distinguished by the remarkable character of the hind feet, each of which has a pair of very conspicuous spurs, or additional toes, situated at some distance above the front toes, and furnished with sharp claws.

Of this species there are two supposed varieties, agreeing in form with the above-mentioned, but differing in size, and in some degree in colour; but the differences are not such as to justify our considering them as specifically distinct. The first of these varieties is the Middle Siberian jerboo, which is of the size of a rat, and has the thighs crossed by a white line; and a whitish zone or circle surrounding the nose.

It is found in the eastern deserts of Siberia and Tartary, beyond the lake Baikal. The other variety is called by Mr. Pennant, the pigmy Siberian jerboa. It agrees in form with the other, but has no white circle round the nose, and has a smaller tuft to the tail, the end of which is tipped with white. In size it is inferior to the middle variety. It is said to inhabit the same places with the large or first described kind.

3. Dipus cafer, or cape jerboa, is by far the largest of all the jerboas, and is a native of the mountainous country to the north of the Cape of Good Hope. It is an animal of great strength and activity, and will spring to the distance of 20 or 30 feet at once. When eating, it sits upright in the manner of a squirrel.

4. Dipus meridianas, or torrid jerboa, according to Dr. Pallas, was first figured by Seba, whose specimen appears to have been not fully grown. Specimens were brought to Dr. Pallas in the year 1770, which were taken on the borders of the sandy desert of Naryn, in 46½° north latitude. The burrows or passages which they had formed in the dry soil, had a triple entrance, and were about an ell deep in the ground. The size of this species is between that of a rat and a field-mouse.

5. Dipus Canadensis, or Canadian jerboa. This minute species is thus described by General Davies, who had an opportunity of examining it during his residence at Quebec.

"During the time the animal remained in its usual vigour, its agility was incredible for so small a creature. It always took progressive leaps of from three to four, and sometimes of five yards, although seldom above 12 or 14 inches from the surface of the grass; but I have frequently observed others in shrubby places, and in the woods, among plants, where they chiefly reside, leap considerably higher. When found in such places, it is impossible to take them, from their wonderful agility, and their evading all pursuit, by bounding into the thickest part of the covert they can find."

DIRCA, a genus of the monogynia order, in the octandria class of plants, and in the

natural method ranking under the 1st order, vepreculæ. There is one species, a small shrub of North America.

DIRECTION, in mechanics, signifies the line or path of a body's motion, along which it endeavours to proceed, according to the force impressed upon it.

DISA, a genus of the gynandria diandria class and order. The spathe is one-valved; petals three, the third less, two-parted, gibbous at the base. There are four species, herbaceous plants of the Cape, with beautiful blue flowers.

DISANDRA, a genus of the monogynia order, in the heptandria class of plants. The calyx has seven leaves; the corolla is parted into seven, and flat; the capsule two-celled. There are two species, pretty trailling plants, natives of Madeira.

DISC, *discus*, in antiquity, a quoit made of stone, iron, or copper, five or six fingers broad, and more than a foot long, inclining to an oval figure, which was hurled in the manner of a bowl, to a vast distance, by the help of a leathern thong tied round the person's hand who threw it, and put through a hole in the middle.

Disc, in astronomy, the body and face of the sun and moon, such as it appears to us on the earth; or the body or face of the earth, such as it appears to a spectator in the moon. The disc in eclipses is supposed to be divided into 12 equal parts, called digits; in a total eclipse of the luminaries, the whole disc is obscured; in a partial eclipse, only a part of it. See Astronomy.

DISCORD, in music, a dissonant and inharmonious combination of sounds, so called in opposition to the concord.

DISCOUNT, a compensation for the advance of money which is not due till after a certain period. The person advancing the money, had he retained it, might have made in the given time a certain rate of interest; therefore if he advances it for the use of another, it is equitable that he should be allowed the same gain as he would have made by retaining it in his own hands during the time for which it is lent. Thus, if a person is entitled to 100*l.* at the end of a year, and has occasion for the money immediately, the sum that ought to be given as an equivalent thereto, allowing 5 per cent. interest, is 95*l.* 4*s.* 9¼*d.*; for the discount of 4*l.* 15*s.* 2¾*d.* which is then retained, will, if improved at 5 per cent interest, amount at the end of a year to 5*l.* and consequently the lender having then 105*l.* will have made the same gain as he would have made by retaining the money. This is the true principle of discount, according to which the tables published by Mr. Smart are computed; but in commercial transactions, the general mode is, to deduct from the sum to be discounted, the simple interest on that sum for the time for which it is advanced. Thus, if 100*l.* is payable at the end of six months, the discount deducted is 2*l.* 10*s.* being the half of a year's interest; or, if 100*l.* is payable at the end of one month, the discount deductod is 8*s.* 4*d.* being the twelfth part of a year's interest. By this means, although the legal rate of interest to be received for money lent is restricted to 5 per cent, the person who employs his money in disconnting, makes a greater rate of interest, and the shorter the periods are for which he discounts, the greater his annual gains. In discounting bills of exchange, the days of grace are included in the time the bill has to run, the discount being calculated to the day on which the money is receivable.

DISCRETE, or *Disjunct Proportion*, is when the ratio of two or more pairs of numbers or quantities is the same, but there is not the same proportion between all the four numbers.

Discrete *quantity*, such as is not continuous and joined together. Such is a number whose parts being distinct units, cannot be united into one continuum; for in a continuum, there are no actual determinate parts before division, but they are potentially infinite.

DISJUNCTIVE *proposition*, in logic, is that where of several predicates we affirm one necessarily to belong to the subject to the exclusion of all the rest, but leave that particular one undetermined.

DISPENSARY, a charitable institution, very common in London and some other large towns of Britain. They are supported by voluntary subscriptions, and each has one or more physicians, surgeons, and apothecaries, who attend, or ought to attend at stated times, in order to prescribe for the poor, and if necessary to visit them at their own habitations. The poor are supplied with medicines gratis. Where these institutions are managed with care they are of the utmost importance to society, it being unquestionably more for the comfort of the sick to be attended at their own houses, than to be dragged from their families to an hospital.

DISPENSATORY, denotes a book containing the method of preparing the various kinds of medicines used in pharmacy. Such are the London, Edinburgh, and Dublin Pharmacopæias.

DISSECTION, in anatomy, the cutting up a body with a view of examining the structure and use of the parts. See Anatomy.

DISSEISIN, in law, is a wrongful putting out of him that is seized of the freehold, which may be effected either in corporeal inheritances, or incorporeal. Disseisin of things corporeal, as of houses and lands, must be by entry and actual dispossession of the freehold. Disseisin of incorporeal hereditaments, cannot be an actual dispossession, for the subject itself is neither capable of actual bodily possession nor dispossession, but is only at the election and choice of the party injured, if, for the sake of more easily trying the right, he is pleased to suppose himself disseised. And so also even in corporeal hereditaments, a man may frequently suppose himself to be disseised, when he is not so in fact, for the sake of entitling himself to the more easy remedy of an assise of novel disseisin, instead of the process of a writ of entry.

DISSIPATION, *circle of*, in optics, is used for that circular space upon the retina, which is taken up by one of the extreme pencils or rays issuing from an object. To understand this, it is to be observed, that when the distance of an object from the eye is too small or too great for perfect or distinct vision, the rays of each pencil, issuing from the object, cannot be united at a point on the retina, but beyond it, or before they arrive at the retina; consequently, the rays of each pencil will occupy a

circular space upon the retina, and this circle is called the circle of dissipation, because the rays of a pencil, instead of being collected into a central point, are dissipated all over this circle.

DISSOLVENT, in general, whatever dissolves or reduces a solid body into such minute parts as to be sustained in a fluid.

DISSOLUTION, in music, is when a sound in the enharmonic genus is lowered three dieses; for thereby that genus is dissolved, and the music, or that interval at least, is chromatic.

DISTANCE, in general, an interval between two things, either with regard to time or place. See GEOMETRY and MENSURATION.

DISTANCE, in navigation, the number of minutes or leagues a ship has sailed from any given place or point.

DISTANCE, in astronomy. The distance of the sun, planets, and comets, is only found from their parallax, as it cannot be found either by eclipses or their different phases, for from the theory of the motions of the earth and planets we know, at any time, the proportion of the distances of the sun and planets from us; and the horizontal parallaxes are in a reciprocal proportion to these distances.

DISTEMPER, in painting, a term used for the working up of colours with something besides water or oil. If the colours are prepared with water, that kind of painting is called limning; and if with oil, it is called painting in oil, and simply painting. If the colours are mixed with size, white of eggs, or any such proper glutinous or unctuous matter, and not with oil, then they say it is done in distemper. In this manner the admirable cartoons at Hampton-court are painted.

DISTICH, a couplet of verses making a complete sense. Thus hexameter and pentameter verses are disposed in distichs.

DISTILLATION, is properly a chemical process by which one body is separated from another, by taking advantage of the relative temperatures at which they assume the elastic form, and afterwards condensing the vapour in a separate vessel. For distillation on a small scale, the simplest apparatus that can be used is the common glass retort, with its receiver; next to this is the alembic which may be made of tinned iron; but if it is required to carry the process to any extent, a still with worm, and suitable accompaniments will be necessary. As these implements will be described under the article LABORATORY, it may suffice to give here an example of the process as carried on in the regular distilleries of this country. The following is the method used by the Scotch distillers in the production of malt whisky.

In making malt whisky, one part of bruised malt, with from four parts to nine of barley-meal, and a proportion of seeds of oats corresponding to that of the raw grain, is infused in a mash-tub of cast iron, with from 12 to 13 wine gallons of water, at 150° Fahr. for every bushel of the mixed farinaceous matter. The agitation then given by manual labour or machinery to break down and equally diffuse the lumps of meal, constitutes the process of *mashing*. This operation continues two hours or upwards, according to the proportion of unmalted barley; during which the temperature is kept up by the affusion of seven or eight additional gallons of water, a few degrees under the boiling temperature. The infusion, termed *wort*, having become progressively sweeter, is allowed to settle for two hours, and is run off from the top, to the amount of about one-third the bulk of water employed. About eight gallons of more water, a little under 200° F. are now admitted to the residuum, *infused* for nearly half an hour with agitation, and then left to subside for an hour and a half, when it is drawn off. Sometimes a third affusion of boiling water, equal to the first quantity, is made, and this infusion is generally reserved to be poured on new *farina;* or it is concentrated by boiling, and added to the former liquors. In Scotland, the distiller is supposed by law to extract per cent 14 gallons of spirits, sp. gr. 0.91917, or 1 to 10 over proof, and must pay duty accordingly. Hence, his wort must have at least the strength of 55¼ pounds of saccharine matter per barrel, previous to letting it down into the fermenting tun; and the law does not permit it to be stronger than 75 pounds. Every gallon of the above spirits contains 4.6 pounds of alcohol, sp. gr. 0.825, and requires for its production the complete decomposition of twice 4.6 pounds of sugar = 9.2 pounds.

To prevent acetification, it is necessary to cool the worts down to the proper fermenting temperature of 70° or 65° as rapidly as possible. Hence, they are pumped immediately from the mash-tub into extensive wooden troughs, two or three inches deep, exposed in open sheds to the cool air; or they are made to traverse the convolutions of a pipe immersed in cold water. The wort being now run into the fermenting tun, yeast is introduced and added in nearly equal successive portions during three days, amounting in all to about one gallon for every two bushels of farinaceous matter. The temperature rises in three or four days to its maximum of 80°; and at the end of 10 or 12 days the fermentation is completed, the tuns being closed up during the last half of the period. The distillers do not collect the yeast from their fermenting tuns, but allow it to fall down, on the supposition that it enhances the quantity of alcohol.

In distilling off the spirit from the fermented wort or wash, a hydrometer is used to ascertain its progressive diminution of strength; and when it acquires a certain weakness, the process is stopped by opening the stop-cock of the pipe which issues from the bottom of the still, and the spent wash is removed. There is generally introduced into the still a bit of soap, whose oily principle spreading on the surface of the boiling liquor, breaks the large bubbles, and of course checks the tendency to froth up.

DISTRESS, in law, is the taking of a personal chattel, out of the possession of the wrong doer, into the custody of the person who is injured, to procure a satisfaction for the wrong committed. It is of two kinds: cattle for trespassing and doing damage, or for non-payment of rent or other duties. But the most usual injury for which a distress may be taken, is that of non-payment of rent.

DIVER, in ornithology. See COLYMBUS.

DIVERGENT, or *diverging lines*, in geometry, are those which constantly recede from each other.

Divergent *rays*, in optics, are those which, going from a point of the visible object, are dispersed, and continually depart one from another, in proportion as they are removed from the object: in which sense it is opposed to convergent. See Optics.

DIVIDEND, in arithmetic, the number proposed to be divided into equal parts. It must always be greater than the divisor.

Dividend *of stocks*, is a share or proportion of the interest of stocks erected on public funds, as the South Sea, &c. divided among, and paid to, the proprietors half-yearly.

DIVING, the art or act of descending under water to considerable depths, and abiding there a competent time. The uses of diving are very considerable, particularly in the fishing for pearls, corals, sponges, &c.

Various methods have been proposed, and engines contrived, to render the business of diving more safe and easy. The great point in all these is, to furnish the diver with fresh air, without which he must either make but a short stay, or perish.

Those who dive for sponges in the Mediterranean, help themselves by carrying down sponges dipped in oil in their mouths. But considering the small quantity of air that can be contained in the pores of a sponge, and how much that little will be contracted by the pressure of the incumbent water, such a supply cannot long subsist the diver. And it has been found by experiment that a gallon of air included in a bladder, and by a pipe reciprocally inspired and expired by the lungs, becomes unfit for respiration in little more than one minute of time. For though its elasticity is but little altered in passing the lungs, yet it loses its oxygen, and is rendered unfit for respiration.

The original diving bell was a very imperfect machine, affording the diver no supply of fresh air while under water. This difficulty was first obviated by Dr. Halley's contrivance of an apparatus for lowering casks of air, from which, by means of a pipe, the diver had a constant supply, and was thus enabled to keep the water out of the bell, and to continue much longer at the bottom.

Several improvements were gradually made in the construction of this machine, while the method of supplying it with air continued nearly the same, until the method attributed to Mr. Smeaton, but claimed by others, was applied with great success. This improvement consisted of a strong leathern pipe, which was connected with the top of the bell to convey air into it from an air-pump placed either in a boat or on the shore.

The celebrated Mr. Rennie has farther improved this principle by the application of a powerful double barrelled air-pump. His diving bell is made of cast iron, having strong lenses inserted in it for the admission of light. Several workmen are enabled to descend in it together, and to carry on the operations of clearing the ground; cutting and blasting rocks; and rearing structures of prodigious magnitude in deep water, with nearly as great facility as on land.

This bell may, by the aid of a vessel fitted up for the purpose, be moved about, and made to sweep over the bottom; it has been thus used in Plymouth sound to discover and take up old anchors, &c.

It is but justice to mention here that on the failure of Dr. Halley's diving bell in Dublin bay, on which occasion two men lost their lives by the bell becoming entangled in its descent, the greater part of the wreck saved from the rich ship Belgiosa, was taken up by means of a bell invented by the late Mr. Adam Walker. Its construction is extremely simple, and in many respects it resembles Mr. Rennie's. We shall here add a brief description of the ingeniously contrived diving bell of Mr. Spalding of Edinburgh, represented in Plate X. Mr. Walker's, which is represented on the same plate, requires no description after what has been said above.

A B C D fig 3, represents a section of the bell which is made of wood, *ee* are iron hooks, by means of which it is suspended by ropes Q B F *e* and Q A E *e* and Q S as expressed in the figure; *cc* are iron hooks, to which are appended leaden weights, that keep the mouth of the bell always parallel to the surface of the water, whether the machine is lighter or heavier than an equal bulk of water. By these weights alone, however, the bell would not sink, another is therefore added, represented at L, and which can be raised or lowered at pleasure, by means of a rope passing over the pulley *a*, and fastened to the sides of the bell M. As the bell descends, this weight, called the balance weight, hangs down a considerable way below the mouth of the bell. In case the edge of the bell is caught by any obstacle, the balance weight is immediately lowered down, so that it may rest upon the bottom, by this means the bell is lightened, and all danger of oversetting is removed, for being lighter without the balance weight than an equal bulk of water, it is evident that the bell will rise as far as the length of the rope affixed to the balance weight will allow it.

By another very ingenious contrivance, Mr. Spalding rendered it possible for the divers to raise the bell with all the weights appended to it, even to the surface, or to stop at any particular depth as they think proper; for this purpose, the bell is divided into two cavities, both of which are made as tight as possible; just above the second bottom, E F, are small slits on the sides of the bell through which the water entering as the bell descends, displaces the air originally contained in its cavity, which flies out at the upper orifice of the cock H. When this is done, the divers turn the handle which stops the cock, so that if any more air was to get into the cavity A E F B, it could no longer be discharged through the orifice H as before. When this cavity is full of water, the bell sinks, but when a considerable quantity of air is admitted, it rises. If therefore the divers have a mind to raise themselves, they turn the small cock, by which a communication is made between the upper and under cavities of the bell; the consequence of this is, that a quantity of air immediately enters the upper cavity, forces out a quantity of water contained in it, and thus renders the bell lighter by the whole weight of the water which is displaced. Thus if a certain quantity of air is admitted into the upper cavity, the bell will descend very slowly; if a greater quantity, it will neither ascend nor descend, but remain stationary; and if a larger

quantity of air be still admitted, it will rise to the top.

Instead of wooden seats, used by Dr. Halley, Mr. Spalding made use of ropes suspended by hooks *b, b, b,* and on these ropes the divers may sit without any inconvenience,

[illegible]

flexible [illegible]ough which the air is admitted to the bell in the ascent and descent of this cask, the pipe is kept down by a small appended weight, as in Dr. Halley's machine; R is a small cock by which the hot air is discharged.

Mr. Spalding is of opinion, that one air-barrel, capable of containing thirty gallons, is sufficient for an ordinary machine.

In fig. 1 and 2, are shewn representations of a frame for supporting a diving bell, and transporting it from place to place upon the water. Fig. 1, is a side elevation, and fig. 2, a section of it. The same letters refer to both figures. A B, fig. 2, are sections of two barges, such as are used upon the Thames, at London: D E F, is a frame lying across the barges, and supporting a beam, G, from which hangs a strong block for the rope by which the bell, H, is suspended; the other end of the rope goes round a windlass, *a*, with a rachet wheel and click to raise and lower the bell as occasion requires: *b d* are smaller blocks, for the ropes to draw up the air barrels; *e f* are rollers, turned by winches, fixed on the opposite barge to the windlass, *a:* the ropes are wound round these rollers in contrary directions, and the winches come close together, so that one man can turn them both at once, and when one rope descends, the other ascends, so as to give a constant supply of air to the divers under the bell H. When the divers wish to come up, they give a signal to that purpose, and the windlass is turned by men, until the bottom of the bell is brought above water; a small boat or raft is rowed under the bell to take the divers out: the same method is to be used to get them in, and this will be done without wetting them. Several small bells of very different tones should be fixed to the beam G, and strings fastened to them should go into the bell for the divers to ring, as signals to the workmen in the barges above. The barges should be well secured together by cross beams.

DIVISIBILITY, that property by which the particles of matter in all bodies are capable of a separation, or disunion from each other.

As it is evident that body is extended, so it is no less evident that it is divisible; for since no two particles of matter can exist in the same place, it follows, that they are really distinct from each other, which is all that is meant by being divisible. In this sense the least conceivable particle must still be divisible, since it will consist of parts which will be really distinct. To illustrate this by a familiar instance, let the least imaginable piece of matter be conceived lying on a smooth plain surface, it is evident the surface will not touch it every where: those parts, therefore, which it does not touch, may be supposed separable from the others, and so on, as far as we please; and this is all that is meant when we say matter is infinitely divisible.

The difference of opinion that exists among philosophers on this point is not likely to be finally removed so long as mankind remain in ignorance respecting the immediate connexion between the existence of matter and the great first cause of its existence. The term *infinite,*

[illegible] imagination itself is limited.

DIVISION, in arithmetic, one of the four fundamental rules, by which we find how often a less number, called the divisor, is contained in a greater, called the dividend; the number of times which the divisor is contained in the dividend being termed the quotient.

Division, in the sea language, the third part of a fleet of men of war, and sometimes the ninth part; which last happens when the fleet is divided into three squadrons: for then each squadron is distributed into three divisions.

DIVORCE, a separation of two *de facto* married together, of which there are two kinds; one *a vinculo matrimonii*, from the very bond of marriage; the other *a mensa et thoro* from bed and board.

DIURETICS, in pharmacy, such medicines as increase the discharge of urine; or which are supposed to have a power of removing obstructions in the urinary passages.

DIURNAL *arch*, the arch or number of degrees that the sun, moon, or stars, describe between their rising and setting.

Diurnal *motion of a planet*, is so many degrees and minutes as any planet moves in 24 hours. Hence the motion of the earth about its axis is called its diurnal motion.

DOCK, in maritime affairs, is an artificial bason, by the side of an harbour, made convenient either for the building or repairing of ships. It is of two sorts, 1. Dry-dock, where the water is kept out by great flood-gates, till the ship is built or repaired, when the gates are opened, and the water let in to float and launch her. 2. Wet-dock, a place where the ship may be hauled into, out of the tide's way, and so dock or sink herself a place to lie in.

Dock-*yards*, in ship-building, are magazines of all sorts of naval stores. The principal in England are those of Chatham, Portsmouth, Plymouth, Woolwich, Deptford, and Sheerness. In time of peace ships of war are laid up in these docks; those of the first-rate mostly at Chatham, where, and at other yards, they receive from time to time such repairs as are necessary. These yards are generally supplied from the northern powers with hemp, pitch, tar, rosin, &c. but as for masts, particularly those of the larger size, they are brought from America.

DOCTOR, a person who has passed all the degrees of a faculty, and is impowered to teach or practise the same: thus we say, doctor in divinity, doctor in physic, doctor of laws.

The title of doctor seems to have been created in the twelfth century, instead of master, by Peter Lombard and Gilbert Porreus, then the chief divines of the University of Paris.

To pass doctor in divinity at Oxford, it is necessary the candidate have been four years batchelor of divinity. For doctor of laws, he

must have been seven years in the university to commence batchelor of law, five years after which he may be admitted doctor of laws.

At Cambridge, to take the degree of doctor in divinity, it is required the candidate have been seven years batchelor of divinity: though in several colleges the batchelor's degree is dispensed with, and they may go out *per saltum*.

DODARTIA, a genus of the didynamia angiospermia class and order of plants, the flower of which consists of one ringent petal, with the upper lip erect and semibifid; and the lower lip patent, twice broader than long, and trifid. There are two species, herbaceous plants of the East.

DODECAGON, in geometry, a regular polygon, consisting of twelve equal sides and angles.

DODECAHEDRON, in geometry, one of the Platonic bodies, or regular solids, contained under twelve equal and regular pentagons.

Its solidity is found by multiplying the area of one of the pentagons by 12, and then this product by one-third of the distance of the face from the centre of the dodecahedron, which is the same with the centre of the circumscribing sphere.

The side of a dodecahedron, inscribed in a sphere, is the greater part of the side of a cube, inscribed in the same sphere, cut into extreme and mean proportion. If the diameter of the sphere be 1.0000, the side of the dodecahedron, inscribed in it, will be .35682 nearly.

All dodecahedrons are similar, and are to one another as the cubes of their sides; their surfaces are also similar, and therefore they are as the squares of their sides.

DODECANDRIA, the name of the 11th class in Linnæus's sexual system, consisting of plants with hermaphrodite flowers, that, according to the title, have twelve stamina. [illegible] class, however, is not limited with respect to the number of stamina. Many genera have sixteen, eighteen, and even nineteen.

DODECAS, a genus of the trigynia order, in the dodecandria class of plants. The calyx is half-quadrifid, having the corolla above; the corolla quinquefid; the capsule unilocular, conjoined with the calyx. There is but one species, a shrub of Surinam.

DODECATHEON, a genus of the monogynia order, in the pentandria class of plants, [illegible] in the natural method ranking under the 21st order, preciæ. There is one species, the D. media, a perennial plant, a native of Virginia.

DODO. See DIDUS.

DODONÆA, a genus of plants of the octandria monogynia class: it has no corolla; the fruit is a roundish trilocular capsule, with prominent inflated angles, containing solitary seeds. There are two species.

DOG, in zoology. See CANIS.

DOLICHOS, a genus of the decandria order, in the diadelphia class of plants; and in the natural method ranking under the 32d order, papilionaceæ. Essential character: two parallel oblong calluses at the base of the standard, compressing the wings underneath. There are thirty-eight species; most of these are annual and natives either of the East or West Indies. They are chiefly herbaceous, with twining stalks; the flowers are frequently in spikes, and axillary; the legume is often smooth, sometimes villose, or pruinent. Mr. Millar affirms that he has cultivated more than sixty, besides many varieties.

DOLIOCARPUS, a genus of the polyandria monogynia class and order. The calyx is five-leaved; corolla three-petalled, plaited; stigma subtrifid; berry globular, crowned; with the style, one-celled, two-seeded. There are three species, shrubs of Guiana.

DOLPHIN. See DELPHINUS.

DOMBEYA, a genus of the class and order diœcia monadelphia. The male, calyx of the ament scales; corolla none; anthers 10 or 12, without filaments. Female, calyx ament with many germs; corolla none; stigma bivalve, unequal; seeds many, in a roundish strobile. There is one species, a tree of Chili.

DOME. See ARCHITECTURE.

DOMESDAY, is a record, made in William the Conqueror's time, and now remaining in the Exchequer, fair and legible, consisting of two volumes, containing a survey of all the lands in England. It was begun by five justices, assigned for that purpose in each county, in the year 1081, and finished in 1086.

DOMINICAL *letter*, in chronology, is that letter of the alphabet which points out in the calendar the Sundays throughout the year, thence also called Sunday-letter. The distribution of days into weeks is made by the seven first letters of the alphabet A, B, C, D, E, F, G, beginning, at the first of January, to place the letter A; to the second of January B is joined; to the third C; and so on to the seventh, where G is figured; and then again beginning with A, which is placed at the eighth day, B will be at the ninth, C at the tenth, and so continually repeating the series of these seven letters, each day of the year has one of them in the calendar.

DONATIA, a genus of the trigynia order, in the triandria class of plants. There is one species.

DONAX, a genus of insects belonging to the order of vermes testacea. It is an animal of the oyster kind; and the shell has two valves, with a very obtuse margin in the fore-part. There are 10 species, principally distinguished by the figure of their shells.

DORÆNA, a genus of the pentandria monogynia class and order. There is one species, a dwarf tree about six feet high, a native of Japan.

DORIC *order*, in architecture, the second of the five orders, being that between the Tuscan and Ionic. See ARCHITECTURE.

DORIC *dialect*, in grammar, one of the five dialects, or manners of speaking, which were principally in use among the Greeks.

DORIS, a genus of insects, belonging to the order of vermes testacea. There are several species. The argo, or lemon doris, has an oval body, convex, marked with numerous punctures, of a lemon colour, the vent beset with elegant ramifications. It inhabits different parts of our seas, and is properly called the sea-lemon.

DORMANT, in heraldry, is used for the

posture of a lion, or any other beast, lying along in a sleeping attitude, with the head on the fore paws; by which it is distinguished from the couchant.

DORMOUSE, in zoology. See Mus, and Sciurus.

DORONICUM, *leopard's bane*; a genus of the polygamia superflua order, in the syngenesia class of plants; and in the natural method ranking under the 49th order, compositæ. There are three species; of which the only one worthy of notice is the pardalianches, with obtuse heart-shaped leaves. It grows naturally in Hungary, and on the Helvetian mountains; but is frequently preserved in the English gardens. It has thick fleshy roots, which divide into many knobs or knees, sending out strong fleshy fibres which penetrate deep into the ground; from these arise in the spring a cluster of heart-shaped leaves, which are hairy and stand upon footstalks: between these arise the flowerstalks, which are channelled and hairy, nearly three feet high, putting out one or two smaller stalks from the side. Each stalk is terminated by one large yellow flower. The plant multiplies very fast by its spreading roots; and the seeds, if permitted to scatter, will produce plants wherever they happen to fall.

DORSAL *muscles*, are the muscles of the back and loins, which are for the most part common.

DORSIFEROUS *plants*, among botanists, such as are of the capillary kind, without stalks, and which bear their seeds on the back-side of their leaves.

DORSTENIA, *contrayerva*; a genus of the monogynia order, in the tetrandria class of plants; and in the natural method ranking under the 53d order, scabridæ. There are eight species, all of them low herbaceous plants, growing in the warm countries of America and China.

DOUBLE-*cast*, in husbandry, a term used by the farmers for that method of sowing that does not dispense the necessary quantity of seed for a piece of land at one sowing, but requires going over every place twice.

DOVE-*tailing*, in carpentry, is the manner of fastening boards together by letting one piece into another, in the form of the tail of a dove. The dovetail is the strongest of jointings, because the tenon, or piece of wood which is put into the other, goes widening to the extreme, so that it cannot be drawn out again.

DOUGLASSIA, a genus of the class and order polyadelphia polyandria. There is one species, a shrub of Guiana.

DOWER, the portion which a widow has of the lands of her husband, after his decease, for the sustenance of herself, and the education of her children.

To the consummation of dower, three things are necessary, viz. marriage, seisin, and the husband's death.

DOWN, the shortest, smoothest, softest, and most delicate feathers of birds, particularly geese, ducks, and swans; growing on their neck and part of the stomach. Down is a commodity of most countries; but that in most repute for fineness, lightness, and warmth, comes from Denmark, Sweden, and other northern countries.

DRABA, a genus of the siliculosa order, in the tetradynamia class of plants, and in the natural method ranking under the 39th order, siliquosæ. There are nine species; of which the only one worthy of notice is the verna, or early whitlow-grass. It has naked stalks, with leaves a little serrated. The blossoms are white, and at night the flowers hang down. It grows on old walls and dry banks. It is one of the earliest-flowering plants we have, and is good to eat as a salad.

DRACÆNA, a genus of the monogynia order, in the hexandria class of plants. There are 14 species, most of them having the habit of the palms, and one of them at least (the D. draco, which is a magnificent plant, or rather tree) affording a red powder, like the eastern dragon's blood.

DRACHM, a Grecian coin, of the value of 7½d. Drachm is also a weight used by our physicians; containing just sixty grains, three scruples, or the eighth part of an ounce.

DRACO, the dragon, in zoology, a genus belonging to the order of amphibia reptilia; the characters of which are these: it has four legs, a cylindrical tail, and two membranaceous wings, radiated like the fins of a fish, by which it is enabled to fly, but not to any great distance at a time. There are two species.

1. The volans, or flying-dragon, with the wings entirely distinct from the fore-legs. It is found in Africa and the East Indies.

2. The præpos, with the wings fixed to the fore-legs. It is a native of America. They are both harmless little creatures, and feed upon flies, ants, and small insects.

Draco *volans*, in meteorology, a fiery exhalation, frequent in marshy and cold countries. It is most common in summer; and though principally seen playing near the banks of rivers, or in boggy places, yet sometimes mounts up to a considerable height in the air, to the no small terror of the amazed beholders; its appearance being that of an oblong, sometimes roundish, fiery body, with a long tail. It is entirely harmless, frequently sticking to the hands and clothes of people without injuring them in the least.

Draco, in astronomy, a constellation of the northern hemisphere, the stars in which, according to Ptolemy, are 81; according to Tycho, 82; according to Hevelius, 40; according to Bayer, 33; and according to Mr. Flamsteed, 80.

DRACOCEPHALUM, dragon's head, a genus of the gymnospermia order, in the didynamia class of plants. There are 15 species, most of them herbaceous, annual, or perennial plants, from 18 inches to three feet high, mostly with entire leaves and spikes of small monopetalous flowers, of a blue, white, or purple colour. The D. canariense is well known by the name of balm of Gilead.

DRACONTIUM, dragons, a genus of the polyandria order, in the gynandria class of plants, and in the natural method ranking under the first order, palmæ. There are five species, all natives of the Indies. The only one which makes any appearance is the pertusum, with leaves having holes, and a climbing stalk. This is a native of most of the West India islands.

DRAINING. See Agriculture.

DRAMA, a poem containing some certain

action, and representing a true picture of human life, for the delight and improvement of mankind.

The principal species of the Drama are two, comedy and tragedy. Some others there are of less note, as pastoral, satire, tragi-comedy, opera, &c. See POETRY.

DRAWBACK, in commerce, certain duties, either of the customs or of the excise, allowed upon the exportation of some of our own manufactures; or upon certain foreign merchandize that has paid duty on importation.

DRAWING, in painting, is the accurate representation and just symmetry of forms and proportions; whence a painter or sculptor is said to know much or little of drawing, according to his skill in these respects; and in like manner a figure of a man or other animal, a building, or any other object represented, is said to be in drawing or out of drawing. Drawing may justly be considered as the basis of painting; for it is but labour lost, when the painter endeavours to disguise by ingenious artifices of colour, the defects of forms which are fundamentally incorrect and incoherent.

DRAWING: a representation of objects on paper, by means of chalk, lead, charcoal, crayon, or common ink, or of Indian ink, or water-colours. When the latter method is used, it is called a washed or coloured drawing. This mode has of late years been improved in a singular degree, and it is at present practised with unprecedented excellence.

DRAWING, *art of.* The art of delineating objects on the surface of any substance whatever. The fundamental part of this art is a knowledge of geometry and perspective: the study of both is therefore the first step towards the attainment of the art of drawing. See GEOMETRY and PERSPECTIVE.

The surest mode for the attainment of excellence in drawing, is to begin with such plain geometrical figures, as squares, arches, circles, ovals, cones, and cylinders, which will be useful in numerous forms of similar proportions; and having acquired sufficient facility and readiness in these figures, then to give to every object its due light and shade, according to its concavity or convexity, so as to convey the perfect idea of the elevation or depression, nearness or distance, of every part.

From this, the next step is the imitation of the forms of fruits, with their leaves; of flowers, herbs, trees of various kinds, &c.

The third step is the representation, in the same manner, of beasts, birds, fishes, &c. &c.

From this the student may proceed to the imitation of the human figure, beginning, as before remarked, with its various parts, as the eye, mouth, hand, foot, &c. &c.; and then the head, arm, leg, trunk; and lastly, the whole figure, carefully observing all its proportions. When he is sufficiently master of the naked form, let him proceed to the study of drapery, learning how to clothe a figure, so as to give it every advantage of ornament, without interruption of its air and motion, grace or symmetry.

To these acquisitions are to be added his study of architecture, landscape, and all inanimate objects, or still life.

The implements and materials most requisite for drawing are:

Drawing-boards for fixing the paper upon, so that it may not shift, and also for straining it, to prevent the colours, when laid wet upon the paper, from causing it to swell up, so as to be uneven. The simplest sort is made of a deal-board, framed square, with a strong piece across each end, to prevent warping. Upon this the paper may be fixed down with pins, or with paste, which is the better method.

The best kind of drawing-boards, however, are made with a frame and a moveable pannel, upon which the paper is simply put wet, and then forced into the frame, where it is confined by wedges at the back. This strains equally well, without the trouble of pasting, so that you may dry it at the fire; and it also looks much neater. These drawing-boards may be bought at most colour-shops. It is necessary to mention, that all the angles of drawing-boards should be exactly square.

Parallel rulers are for drawing parallel lines very readily; the best kind of parallel ruler is the rolling one, invented by Mr. Eckhardt.

T-squares are rulers made in the form of the letter T, which are used with the drawing-boards; the short end, called the stock, being applied to the edge of the board, so as to slide forwards and backwards, while the long part, called the blade, is used for drawing lines by. These are more convenient than parallel rulers, when a drawing-board is used, as by them you draw lines at right angles to each other at once, without using the compasses.

Dividing-compasses are instruments of brass and steel, for dividing lines, and laying down measures from scales, &c. They are generally sold in cases, containing also a steel pen, for drawing lines cleaner than can be done by a common pen, which is very useful where neatness is required; and points with a black-lead pencil, for putting into the compasses, when circles are to be described.

These cases also contain scales of equal parts, sectors, and protractors for laying down angles.

Black-lead pencils are indispensably necessary, and they are to be had of various degrees of hardness, and different depths of shade, according to the purpose for which they are wanted.

Indian ink. This substance comes from China, where it is used for common writing, which is there performed with a brush instead of a pen. It is a solid substance, of a brownish-black colour; and the composition is not known, but is conjectured to be the gall of a species of cuttle-fish. When ground up with water upon a clean tile or earthenware plate, it may be made either lighter or darker, as required, by adding to it more or less water. The best Indian ink is always stamped with Chinese characters, breaks with a glossy fracture, and feels smooth, and not gritty, when rubbed against the teeth. An inferior kind is made in this country, but it may be easily known by its grittiness. Sepia is now very much used in preference to Indian ink.

Hair-pencils are made of camels' hair, put into a goose or swan's quill. To choose these, moisten them a little in the mouth, and if they come to a point without splitting, they are good; if they do not, they are not fit for drawing with.

Charcoal is used for slightly sketching the outlines of figures, in order to get the propor-

tions previous to making a drawing in chalk. The best charcoal for this purpose is that of the willow; it is cut into slips, and the strokes made with it may easily be rubbed out with a feather of goose's or duck's wing.

Black-chalk is a fossil substance, resembling slaty coal, which is cut into slips for drawing. It is generally used in an instrument called a port-crayon, which is made either of steel or brass. It is much employed for drawing figures, and is the best substance for this purpose, in making drawings from plaster, or after the life. It is more gritty than black-lead, but is of a deeper black, and has not the glossiness of the former.

For mellowing and softening the shadows into each other, when black chalk is used, stumps are necessary. They are pieces of soft leather, or blue paper, rolled up quite tight, and cut to a point.

White chalk is used, together with black, for laying on the lights. This is different from common chalk, being much harder. Tobacco-pipe clay will answer the purpose.

Red chalk is a fossil substance of a red ochrey colour, which is sometimes used for drawing, but not so much now as it formerly was, the black being preferred; however, the red being cheaper, will do very well for some purposes.

Drawing-paper. Any paper that will do for writing will do for drawing; but as the wire marks in common writing-paper are injurious, paper made without any wire-marks, called wove-paper, is generally used for this purpose. It is made of various sizes and thickness.

Middle-tint paper, is paper of a brownish or of a grey colour, which is used for drawing upon with black and white chalk. Being of a dark colour, the strokes of the white chalk are distinctly seen; and it saves time in making drawings, as the tint of the paper answers for the half-shadow, so that all that is necessary to be done is to lay in the dark shadows and the lights.

We proceed to give directions for the practice of these rules, and the use of the materials which have been mentioned.

Mechanical Drawing.—In giving instructions for the study of drawing, attention must be paid to the particular branch of this art, to which the student wishes most to apply himself. If his object be the study of architecture, machinery, plans, elevations, sections, &c. then geometry will form the foundation of all his future acquirements. The study of perspective necessarily follows, and with these two sciences he must be intimately acquainted. To these he must add a thorough knowledge of the doctrine of shadows, which is best acquired by studying from models.

Having completed the outlines, Indian-ink is used for shadowing, as it may be diluted with water, so as to be of any required darkness, and may be softened off, where the objects require it, with water only and a hair-pencil. This branch of drawing we consider as a useful rather than an ornamental art. It should be learned by every person, as answering the same purposes with writing, but in a much more perfect manner, in those cases to which it is applicable. This is particularly striking in descriptions of apparatus, and machinery of every kind.

Drawing of flowers, fruits, trees, &c.—This first advance in art is so easy as to require little else than strict attention to imitate the objects placed before the eye, observing well those particularities which give the peculiar character of each, and mark the distinctness of the several species. In trees especially care is to be taken that the oak, ash, elm, &c. may each have its proper and distinct trunk, boughs, and foliage, in such a manner, that it shall be no more possible to mistake one kind of tree for another in the drawing than it is in nature. Nothing is more prejudicial to the student's progress than a habit of indiscriminate forms, which, although they denote a tree in general, do not decide its species.

Drawing of beasts, birds, fishes, &c.—In this step the student must not only study the forms of each class of the several animals, in the same manner as, in the preceding stage, he studied those of trees, but he must begin to observe the varieties of form, induced by the motions of the muscles, in all the actions of the head, body, or limbs, as well as the expression of face, characteristic action, and every other circumstance which distinguishes these from inanimate objects. In drawing beasts he will begin to find the necessity of acquiring a general knowledge of anatomy.

The student who is unacquainted with the form and construction of the several bones which support and govern the animal frame, or does not know in what mode the muscles, moving those bones, are fixed to them, can make nothing of what appears of them through the integuments with which they are covered, which appearance, however, is the object of his pencil.

Drawing the human figure.—The study of the human figure has always been considered by artists as the most important part of the art. It is the most difficult, and is by many considered as contributing the most of any to general improvement; though there are some who carry this idea to too great an extent, affirming, that a person who can draw the human figure well, can draw every thing besides. But this, it is well known, is not the case, there being many artists who can draw the figure very well, who cannot draw landscape nor architecture.

In learning to draw the human figure, it is necessary to begin with each of the parts separately, and after sufficient practice in that way, to proceed to put them together in the complete figure. For instance, the head being the most important part of the human body, it should be studied first. For this purpose, the student should copy the best drawings he can procure of the eye, mouth, nose, and ear, separately and on a large scale; and of these a front view, profile, or side view, oblique view, &c.

The false lines of the black lead may be removed by the Indian rubber; but the student must be as sparing as possible of this, as it is more improving to endeavour to draw every thing correct and decided at once.

The shadows may be laid on by drawing parallel curve-lines, according to the situation of the part, crossing them occasionally, and softening them in with more delicate lines, where necessary.

All the parts of a human figure are composed

of curved surfaces; no straight lines are ever admissible, but every line should have a graceful turn. Care should be taken that no lines ever cross each other at right angles, which gives a disagreeable net-like appearance; neither should the crossings be too oblique, as then they are confused; a proper medium will be acquired by the study of good drawings or prints. Sometimes the shadows are rubbed in with a stump, which is a very expeditious way, and produces a fine effect; but it should be used with discretion, as it is better to execute the shadows in a clear and regular manner by soft lines. Care should be taken not to make the lines harsh and hard, like those of an engraving; they should be softer and more mellow. On this account, drawings are much better to learn from than prints, as, by copying the latter, the student is very apt to acquire a dry and hard manner. But we particularly caution him to avoid copying with a pen all the lines in engravings used for the shadows, which some, who have not been accustomed to see good drawings, are apt to do.

In copper-plate engravings, there other means of producing shadows than by lines, at least with an equal effect; but this arises from the nature of the process: and in drawing, which is of a very different nature, there is not the same necessity for them. In general it should be observed, that the less labour there appears in any drawing, the better it is; and that though every possible pains should be taken to make drawings or paintings excellent, yet this labour should be always disguised as much as possible, and the whole should appear as if executed with the greatest ease.

The way to avoid mediocrity is by the study and imitation of beautiful productions, or, of the most finished translations that have been made from them; for so we may call beautiful prints. Let [illegible] aughtsman study the heads of Raffaelle, an[illegible] e will not see without disgust the sordid figures of indifferent painters.

Having copied frequently the parts of a face, he is next to proceed to the entire head, drawing first a front view, then a profile, a three-quarter, and so on, varying it in every possible direction, till he is thoroughly acquainted with the appearance of all the principal lines in every situation.

The young artist, ought, if practicable, to visit the Royal Academy, or any other public school for drawing, where he will see, at a glance, how the light should be disposed, to draw with effect; if that is impossible, he must remember to throw one light downward on the object, whether it proceeds from the day or a candle; and that he cannot too strictly attend to the true proportions of the body and limbs, as nothing is more disgusting than a want of proportion in these. To prevent his falling into such errors, let him observe, that in a well-formed person, his arms extended make a distance between the extremities of the middle fingers equal to his length; that the face consists of three exact divisions, from the hair on the forehead to the eyes, from the eyes to the bottom of the nose, and from that to the chin. The whole figure is ten faces in length; from the chin to the collar-bone is twice the length of the nose, thence to the lowest part of the breast one face, from that to the navel another, to the groin one, to the upper part of the knee two, the knee is half a face in length, from the lower part of which to the ancle is two faces, and hence to the sole of the foot is one half. Measuring from the extremes of the breast, the breadth will be found to contain two faces, and the bone of the arm from the shoulder to the elbow, the same number; thence, including part of the hand, two faces; and from the shoulder-blade to the hollow between the collar-bones, is one face. The thumb is the length of the nose; from the commencement of the hand to the middle of the arm is five lengths of the nose; and from the pectoral muscle to the same place is four. The great toe is of the length of the nose, and the sole of the foot is the sixth part of the length of the figure; the hands are double their breadth in length, and when extended they are exactly the length of the face. The breadth of the limbs varies according to the state of health in the body, and the particular situation of the muscles whenever moved.

The proportions of children are generally thus; three heads in length from the crown of the head to the groin, and thence to the sole of the foot two, one head and a half between the shoulders, one, of the body between the hips and armpits; the breadth of the limbs should be ascertained from a healthy child.

It is impossible to draw a perfectly beautiful figure from any one person: the most skilful statuaries and painters, sensible of this fact, have composed their finest works from different subjects, as it is very common for the possessor of a truly Grecian head to have a deformed trunk, or another to have graceful limbs and the face of a gorgon. To draw a figure correctly, the intended length should be marked, and all the preceding admeasurements strictly adhered to, beginning the sketch on the left hand, with the head, following by the shoulders, the trunk, the leg most in action, then the other, finishing with the arms, and making the outline perfect before any part is finished; as we may imagine a living or plaster model placed before the student, that will serve better for improving him than any written instructions, but he will find the greatest difficulty in correctly copying the eyes, mouth, ears, hands, and feet, and should consequently be particularly careful when employed on those parts to which rules are utterly inapplicable.

Drawing of Drapery.—In the art of clothing the figures, or casting the drapery elegantly upon them, many things are to be observed. 1. The shape and proportion of the part or limb, which the drapery is supposed to cover, must appear, at least so far as art and probability will permit. 2. The drapery must not sit too close to the parts of the body, but seem to flow round, as it were to embrace them, yet so as that the figure may be easy, and have a free motion. 3. The draperies which cover those parts that are exposed to great light, must not be so deeply shaded as to seem to pierce them; nor should those members be crossed by folds that are too strong, lest by the too great darkness of their shades the limbs look as if they were broken. 4. The great folds must be drawn first, and then stroked into lesser ones; and great care must be taken that they do not cross one another im-

properly. 5. Folds, in general, should be large, and as few as possible: but they must be greater or less according to the quantity and quality of the stuffs of which the drapery is supposed to be made. The quality of the persons is also to be considered in the drapery. 6. Suit the garments to the body, and make them bend with it, according as it stands in or out, straight or crooked, or as it bends one way or another; and the closer the garment fits to the body, the narrower and smaller must be the folds. 7. Folds well imagined give much spirit to any kind of action; because their motion implies a motion in the acting member. 8. An artful complication of folds in a circular manner greatly helps the foreshortenings. 9. All folds consist of two shades and no more; which you may turn with the garment at pleasure, shadowing the inner side deeper, and the outer more faintly. 10. The shades in silk and fine linen are very thick and small, requiring little folds, and a light shadow. 11. Observe the motion of the air or wind in order to draw the loose apparel all flying one way; and draw that part of the garment that adheres closest to the body before you draw the looser part that flies off from it, lest, by drawing the loose part of the garment first, you mistake the position of the figure. 12. Rich ornaments, when judiciously and sparingly used, may sometimes contribute to the beauty of draperies; but such ornaments are far below the dignity of angels or heavenly figures; the grandeur of whose draperies ought rather to consist in the boldness and nobleness of the folds, than in the quality of the stuff, or the glitter of ornaments. 13. Light and flying draperies are proper only to figures in strong motion, or in the wind: but when in a calm place, and free from violent action, their draperies should be large and flowing.

Drawing of landscapes.—Having made himself master of the principal difficulties in perspective, the artist should next copy some good drawings; and here it is of great importance that what he copies should be very excellent; for it is an absurd notion, that indifferent drawings will do to begin with, or to bring the hand in, as it is termed; but, as a great master justly observes, the most likely effect these can produce, will be to put the hand out.

In choosing drawings to copy for beginners, particular attention should be paid to select those where the outlines or forms of the objects are distinctly and correctly drawn, and not those in which a good effect only has been principally aimed at. The first thing to be studied is, to be able to express with the black-lead pencil, the forms of all sorts of objects; and till this is attained, no attempt should be made at finished drawings.

Black lead is the most useful material for drawing the outlines of landscapes, which are best executed with this alone, and should not be gone over afterwards by the pen, which generally gives an appearance of hardness.

Indian ink alone should be used for the shadows till the student has advanced very considerably; nor till then should colours of any kind be used. Beginners are always desirous of producing pictures and making coloured drawings: but nothing is more hurtful than the practising this too early. The first thing to be learned is, to draw forms correctly; next, the mode of shadowing objects truly; then the general light and shadow of a drawing, and, with this, good composition. All this is best learned by using black lead, black chalk, white chalk, Indian ink, and these separately or combined, according to the taste of the student; but he should never think of colours till he has made very considerable

he fewer colours that are used in a drawing the better, as harmony is most easily preserved, and by the mixture of a few, every possible tint may be obtained.

The best sort of water colours are those mixed with gum and made up into cakes, as these may be used by rubbing upon a tile, in the same manner as Indian ink.

GENERAL RULES.

Correctness of outline.—This is the first point to be attained, and can only be the result of patient diligence and long practice. To gain the free use of the pencil or port-crayon, let the student accustom himself to hold it farther from the point than a pen is held in writing, by which means he will have the full command and direction of it. In drawing figures in Indian ink, the use of the pencil is to draw the first sketches or outlines; as any stroke or line that is amiss, may in this be easily rubbed out; and when you have made your sketch as correct as you can with the pencil, you may then draw carefully the best outline you have got, with your crow-quill pen and ink. The ink made use of for this purpose, must be Indian ink; being much softer than the other, and not running; and by mixing it with water, it may be made to any degree of strength and used in a pen. After using the ink, you may wipe out the pencil-lines by rubbing the piece gently with the crumb of stale bread. Having thus got the outline discharged; the next thing is to shade the figures, as directed; either by drawing fine strokes with your pen, where it requires to be shaded, or by washing it with Indian ink. As to the rule and compasses, they are never or rarely to be used, except in measuring the proportion of your figures, after you have drawn them, to prove whether they are right or not; or in houses, fortifications, and other pieces of architecture.

Red lead and red or black chalk are used in the same manner as black lead. White chalk and tobacco-pipe clay are used in heightening or giving strong lights, and in drawing on coloured paper. Pastils or crayons are any colours, mixed with tobacco-pipe clay, which, while soft and in the consistency of a paste is rolled up in pieces, about the thickness of a quill, and two or three inches in length, and then dried: they are generally used on coloured paper; and the colours are rubbed and wrought one into another in such a manner that no strokes appear, but the whole looks as if done with a brush.

Of the general distribution of lights and shades.—As soon as the learner has made himself acquainted with the drawing of forms, his next endeavour must be to learn the art of disposing the light and shade of every object properly. The best rule for doing this is, to

consider from what point, and in what direction, the light falls upon the objects which he is delineating, and to let all his lights and shades be placed according to that direction throughout the whole work. It is the artful management of light and shade that gives the appearance of substance, roundness, and distance, to whatever bodies are represented by drawing. Draw a circle on a piece of paper; fill it up with any even colour, and it will appear to be a body with a round circumference and flat sides; but by colouring it stronger in the middle, and causing it gradually to weaken towards the circumference, it will receive a convex appearance like a ball or globe. In rounding the parts of any object, the extremities in turning must lose themselves insensibly, and without precipitating the light all of a sudden into the shadows, or shadows into the light, but the passage of the one into the other must be imperceptible. Objects that are painted light, must have a sufficient breadth of shadow to sustain them; and dark bodies must have a sudden light behind, to detach them from the ground, or from those objects that are placed behind them.

There should be a balance preserved between the lights and shadows: a broad light ought not to be introduced into a draught without a large shadow The nearer any object is to the eye, it is seen so much the stronger; the sight is weakened by distances, and the more remote any object is, it is seen in a more imperfect manner. Therefore, those objects which are placed foremost to the view, ought to be more finished than those that are cast behind; and they should have such a relative dominion over each other, that as one object by its heightening causes others to retire backwards, so the same object must be chased, and made to appear farther from the sight than others which are more strongly illuminated.

It is not sufficient that remote objects be only coloured in a more faint and languid manner; but, according to their distance, the parts must appear more or less confused; the eye not being able to discover minutely what is far separated from it. Pure and unmixed white either draws an object nearer, or carries it off to a greater distance. If it be accompanied with black, the opposition of light and dark renders the object more sensible, and brings it nearer to the advanced part; but pure white, being the lightest of colours, unless it be forced forwards, and supported by black, will fly off to the remotest view. As for pure black, it is the heaviest of all colours, and brings the objects nearer to the sight: it must be placed in masses, be insensibly confused, and have its proper reposes.

In the representation of bodies, give them always such lights as are most proper and convenient to their supposed situations. If the objects are in the fields or open air, and the sun not visible, or obscured by clouds, you must then introduce almost an universal light, though not warm and strong, and your shades must be faint; but when the sun is conspicuous, and shines in its full lustre, then the light must be very strong and bold, and the shadows very dark. A small light illuminating the body occasions the shadows on the dark side to be large, and their extremities to be very bold. On the other hand, a broad light makes the shadows on the darker side to be more distinct and more soft in their limitations.

Reflection is to be used in delineating glittering or shining bodies, as glass, pearls, silver, &c. Let the cause of the reflection, be it more or less, be seen in the thing itself. Place all your lights one way through the whole work; and if the light falls sideways on the picture, the other side, which is the farthest from the light, must be made the darkest. That part of the body must be made lightest which has the light most opposite to it; if the light be placed above the head, then the top of the head must be made lightest; the shoulder must receive the next greater degree of light; and thus must you continue to shade, losing the light by degrees. By how much one part of the body projects more than another, it must by so much be made the lighter: and, on the contrary, those parts that bend inwards must be made so much the darker. Two equal lights must never be made in the same picture; the greater must strike forcibly into the middle, and with greatest lustre on those parts of the design where the principal figures and strength of the action seem to lie, diminishing it gradually as it approaches nearest the extremities of the piece.

PARTICULAR DIRECTIONS.

In drawing after a picture or print, take care to place it in such a light that the gloss of the colours may not interrupt your view, but so that the light and your eye may fall equally and obliquely upon the piece. Let the piece be placed at such a distance, that you may view it all at once: and the larger the picture is, it should be placed at the greater distance: but right before you, and a little reclined.

Draw all your outlines at first very faint, that they may be easily rubbed out again. The outlines next the light should be drawn more faint; and when you have drawn one feature it should be a direction for you, in some measure, to draw another, by observing with your eye the distance from that to the next feature, making a mark at the place with your pencil, then draw it, and so on to the next, till you have drawn the whole.

Then observe the middle of the picture you would copy, and touch upon the paper with the point of your pencil; afterwards observe the more conspicuous and uppermost figures, if there are more than one, which you are to touch lightly in their proper places. Thus running over the whole draught, you will see, as it were, the skeleton of the piece you are to draw.

Having made out these sketches, view them diligently, to see if they answer your pattern or not; for the gestures of the life ought to shew themselves eminently in the first and rudest draught of the piece; correct and amend whatever you perceive amiss; adding and diminishing as it varies from the pattern.

Of drawing faces.—In drawing a head, it is usually divided into four equal parts: 1. From the crown of the head to the top of the forehead. 2. From the top of the forehead to the eyebrows. 3. From the eyebrows to the bottom of the nose. 4. From hence to the bottom of the chin. But this proportion is not con-

stant; those features, in different men, being very often different as to length and shape. In a well-proportioned face, however, they are nearly right.

Touch the features lightly, where the eyes, nose, mouth, and chin, should stand: then begin to draw them more exactly, and so proceed till you have finished the face; after which draw the hair, beard, and shadows about it. You are to consider all those chief touches which give life to a face, and that discover the disposition of the mind: thus the mouth extended, and the corners turning a little up, shews a smiling countenance, &c. You must take care that the shadows are not made too dark where they should be light, because afterwards they cannot be rendered more light.

Of drawing mixed figures.—In order to draw the form of any beast, or bird, you must be well acquainted with its shape and actions, without which you will never perform any thing well in this way; and whatever beast you draw, give a sketch of the landscape of the country natural to that beast.

In drawing birds, the feathers, beginning at the head, very small, must fall backwards one way in five ranks, still increasing till finished.

Insects, as flies, bees, wasps, grasshoppers, worms, and such-like, are drawn with great ease, provided you, for the first time, have the original before your eyes.

In drawing a flower, begin from the rose-tuft, or wart in the middle; as in a rose or marigold with the yellow tuft; which being made, draw lines equally divided from thence to the greatest compass or extent of the flower. They may be drawn either fully open, or in the bud; the leaves may be first drawn rudely, afterwards giving them their vians, or jaggedness.

Of drawing landscapes, buildings, &c—All true drawing consists in nicely measuring the distances of each part of your piece by the eye.—In order to facilitate this, you are to imagine in your mind that the piece you copy is divided into squares; as for example; suppose or imagine a perpendicular and a horizontal line crossing each other in the centre of the picture you are to copy: then suppose also two such lines crossing your own copy Observe in the original what parts of the design those lines intersect, and let them fall on the same parts of the supposed lines in your copy. If you are to draw a landscape from nature, take your station on a rising ground, where you may have a large horizon, and mark your paper into three divisions downwards, from the top to the bottom; and divide in your own mind the landscape you are to take into three divisions also. Then turn your face directly opposite to the middle of the horizontal line, and draw what is directly before your eyes upon the middle division of your paper; then turn your head, but not your body, to the left hand, and delineate what you view there joining it properly to what you had done before. Lastly, do the same by what is to be seen on your right hand, laying down every thing exactly, both with respect to distance and proportion. Make the nearest objects in your piece the highest, and those that are further off to shoot away lower and lower, till they come almost level with the line of the horizon; lessening every thing proportionably to its distance, and observing also, to make your objects fainter and less distinct the farther they are removed from your eye. Make all your lights and shades fall one way; and let every thing have its proper motion.

Transparencies, were at one time extremely fashionable, and are still used as blinds for windows, and as substitutes for painted glass. Their effect is highly pleasing when the lights are clear and brilliant, and the shades judiciously contrasted with them. In painting transparencies much depends upon the choice of the subject; and none is so admirably adapted to this species of effect as the gloomy Gothic ruin, whose antique towers and pointed turrets finely contrast their dark battlements with the pale yet brilliant moon. The effect of rays passing through the ruined windows half-choked with ivy; or of a fire among the clustering pillars and broken monuments of the choir, round which are figures of banditti, or others, whose haggard faces catch the reflecting light: these afford a peculiarity of effect not to be equalled in any other species of painting. Internal views of cathedrals also where windows of stained-glass are introduced, have a beautiful effect.

The following is the method most commonly used in painting transparencies. Fix the paper intended for this purpose in a straining frame, draw the design, and colour it in the usual manner, then placing it against a window, examine where the shades require strengthening, which will be sometimes necessary on the back of the drawing, and with the opaque substances of ivory or lamp-black, mixed with gum water; having completed it to the due effect, the brightest parts, as the moon or a fire, are to be impregnated with spirits of turpentine on each side of the paper, and the next lights on one side only; those must be covered again with a varnish, composed of two equal portions of spirits of turpentine and Canada balsam, but with great care lest it spread beyond the desired limits. The moon must not be coloured, but fire and flame will require red lead and gamboge.

There are various methods of making drawings by artificial means, such as tracing against the light of a window, using tracing paper, &c. but these, however useful they may be to the mere mechanic, should never be had recourse to by the aspiring artist, as they only tend to check his progress by cramping his genius.

The plates which accompany this article, and which are wholly confined to the drawing of the human figure, have the different articles arranged in progressive order, beginning with the simplest: and it is particularly recommended to the student that he carefully observe this order: and that he practise each figure until he can sketch it correctly, as by this method he will most effectually secure success.

DREAMS. Dreams may be defined to be those vain and transient illusions which are formed in the imagination during sleep.

Various theories have been advanced by philosophers on the subject of dreaming, but none of them can be pronounced to be perfectly satisfactory. Perhaps the reasoning of Dugald Stewart on the subject is as worthy of attention as any thing of the kind extant; but

we are persuaded that before an unobjectionable theory can be established, the functions of the brain must be better understood than at present they are.

DREIN, in military tactics, a trench made to draw the water out of a moat, which is afterwards filled with hurdles and earth, to facilitate the passage over the mud.

DRESSING *of ores*, the breaking and powdering them in the stamping mill, and afterwards washing them in a wooden trough.

DRIFT, in naval language, the angle which the line of a ship's motion makes with the nearest meridian, when she drives with her side to the wind and waves, and is not governed by the power of the helm. It also implies the distance which the ship drives on that line.

DRILL, in mechanics, a small instrument for making such holes as punches will not conveniently serve for.

Drill, or *drill-box*, a name given to an instrument for sowing land in the new method of horse-hoeing husbandry. It plants the corn in rows, makes the channels, sows the seeds in them, and covers them with earth when sown; and all this at the same time, and with great expedition. The principal parts are the seed-box, the hopper, the plough and its harrow, of all which the seed-box is the chief. It measures, or rather numbers, out the seeds which it receives from the hopper, and is for this purpose as an artificial hand; but it delivers out the seed much more equally than can be done by the hand.

DRINK, a part of our ordinary food in a liquid form, serving to dilute and moisten the dry meat.

DRIVING, in the sea language, is said of a ship when an anchor being let fall will not hold her fast, nor prevent her sailing away with the tide or wind.

DRONE, a kind of bee, larger than the common working or honey bees: it is so called from its idleness, as never going abroad to collect either honey or wax.

DROPS, in meteorology, small spherical bodies which the particles of fluids spontaneously form themselves into, when let fall from any height. This spherical figure, the Newtonian philosophers demonstrate to be the effect of corpuscular attraction.

DROPSY, in medicine, an unnatural collection of watery humours in any part of the body.

DROSERA, or *sun-dew*, a genus of the pentagynia order, in the pentandria class of plants, and in the natural method ranking under the fourteenth order, gruinales. There are nine species, two of which grow naturally in boggy places in many parts of the kingdom. They seem to receive the name of sun-dew from a very striking circumstance in their appearance. The leaves are fringed with hairs supporting small drops or globules of a pellucid liquor like dew, which continue even in the hottest part of the day and in the fullest exposure to the sun. The whole plant is acrid, and sufficiently caustic to erode the skin: but some ladies mix the juice with milk, and apply it to remove freckles. The juice that exudes from it unmixed, will destroy warts and corns.

DROWNING, signifies the extinction of life by immersion in water. In some respects there seems to be a great similarity between the death occasioned by immersion in water, and that by strangulation, suffocation by fixed air, apoplexies, epilepsies, sudden faintings, violent shocks of electricity, or even violent falls and bruises.

The following are the directions given for the recovery of drowned persons by the Royal Humane Society of London, and which, in furtherance of the benevolent object of that Society, are here inserted.

1. As soon as the patient is taken out of the water, the wet clothes, taken off with all possible expedition on the spot (unless some convenient house is very near,) and a great coat or two, or some blankets if convenient, should be wrapped round the body.

2. The body is to be carefully conveyed in the arms of three or four men, to the nearest house, where a good fire, if in the winter season, and a warm bed, can be made ready for its reception. As the body is conveying to this place, great attention is to be paid to the position of the head; it must be kept supported in a natural and easy posture, and not suffered to hang down.

3. In cold or moist weather, the patient is to be laid on a mattress or bed before the fire, but not too near, or in a moderately heated room; in warm and sultry weather, on a bed only. The body is then to be wrapped as expeditiously as possible with a blanket, and thoroughly dried with warm coarse cloths or flannels.

4. In summer or sultry weather too much air cannot be admitted. For this reason it will be necessary to set open the windows and doors.

5. Not more than six persons are to be present to apply the proper means; a greater number will be useless, and may retard, or totally prevent, the restoration of life, by rendering the air of the apartment unwholesome.

6. It will be proper for one of the assistants, with a pair of bellows of the common size, applying the pipe a little way up one nostril, to blow with some force, in order to introduce air into the lungs; at the same time the other nostril and the mouth are to be closed by another assistant, while a third person gently presses the chest with his hands, after the lungs are observed to be inflated. If the pipe of the bellows is too large, the air may be blown in at the mouth, the nostrils at the same time being closed, so that it may not escape that way.

7. Let the body be gently rubbed with flannels, sprinkled with spirits. A warming-pan heated (the body being surrounded with flannel) may be lightly moved up and down the back. Fomentations of hot brandy are to be applied to the pit of the stomach, loins, &c. and often renewed. Bottles filled with hot water, heated tiles covered with flannel, or hot bricks, may be efficaciously applied to the soles of the feet, palms of the hands, and other parts of the body. The temples may be rubbed with spirits of hartshorn, and the nostrils now and then tickled with a feather; and snuff, or eau de luce, should be occasionally applied.

8. Tobacco-fumes should be thrown up the fundament: if a fumigator is not at hand, a common pipe may answer the purpose.

The operation should be frequently performed, as it is of importance; for the good effects of this process have been experienced in a variety of instances. But should the application of tobacco-smoke in this way not be immediately convenient, or other impediments arise, clysters of this herb, or other acrid infusions with salt, &c. may be thrown up with advantage.

9. When these means have been employed a considerable time without success, and a brewhouse or warm bath can be readily obtained, the body should be carefully conveyed to such a place, and remain in the bath, or surrounded with warm grains, for three or four hours. If a child has been drowned, its body should be wiped perfectly dry, and immediately placed in bed between two healthy persons. The salutary effects of the natural vital warmth, conveyed in this manner, have been proved in a variety of cases.

10. While the various methods of treatment are employed, the body is to be shaken every ten minutes, in order to render the process of animation more successful; and children in particular, are to be much agitated, by taking hold of their legs and arms frequently and for a continuance of time.

11. If there are any signs of returning life, a spoonful of any warm liquid may be given; and if the act of swallowing can be performed, a cordial of warm brandy or wine may be given in small quantities and frequently repeated.

12. Electricity may be tried by the judicious and skilful, as its application neither prevents nor retards the various modes of recovery already recommended; but, on the other hand, will most probably tend to render the other means employed more certainly and more expeditiously efficacious.

The methods which have been described, are to be employed with vigour for three hours or upwards, although no favourable circumstances should arise; for it is a dangerous error to suppose that persons are irrecoverable because life does not soon make its appearance. Bleeding is never to be employed in such cases, unless by direction of one of the medical assistants, or some other gentleman of the faculty who has paid attention to the resuscitating art.

DRUG, a general term for goods of the druggist and grocery kinds, especially for those used in medicine and dying.

DRUGGET, in commerce, a stuff sometimes all wool, and sometimes half wool half thread, sometimes corded, but usually plain.

DRUM, is a martial musical instrument in form of a cylinder, hollow within, and covered at the two ends with vellum, which is stretched or slackened at pleasure by the means of small cords and sliding knots. Some drums are made of brass, but they are commonly of wood.

There are several beats of the drum, as assembly, chamade, reveille, retreat, &c.

Drums, *kettle*, are large basons of copper or brass, rounded in the bottom, and covered with vellum or goat-skin, which is kept fast by a circle of iron, and several holes fastened to the body of the drum, and a like number of screws to screw up and down. They are much used among the horse, as also in operas, oratorios, concerts, &c.

DRUNKENNESS, a well known disorder in the brain, occasioned by drinking too freely of spiritous liquors. The crime of drunkenness is severely punished in some countries; in our own, it is still punishable by an ancient statute; but notwithstanding this, and even in defiance of the innumerable miseries that attend it, there is scarcely any vice more extensively prevalent. Indeed it may be said to be the cardinal vice of a numerous class of society; it possesses such charms, in their estimation, as to form the very bond of their union; its inspiring qualities seem necessary to fit them for the discharge of those operations on which their sustenance depends; and thus that portion of bodily labour which nature intended to subserve the prolongation of human life, is, by a most unaccountable insanity, employed in cutting short its allotted period.

DRUPA, or *druppa*, in botany, a species of pericarpium, or seed-vessel, which is succulent or pulpy, has no valve or external opening like the capsule and pod, and contains within its substance a stone or nut. The cherry, plum, peach, apricot, and all other stone-fruit are of this kind.

DRY *rot*, a disease incident to timber used for building, such as flooring-boards, joists, wainscoting, &c. Dr. Darwin is of opinion, that the dry-rot may be entirely prevented, by soaking the timber first in lime-water, till it has absorbed as much of it as possible, and, after it has become dry, immersing it in a weak solution of vitriolic acid in water, which he supposes will not only preserve it from decay for many centuries (if it be kept dry,) but also render it less inflammable; a circumstance that merits considerable attention in constructing houses.

Sir Humphrey Davy recommends a weak solution of the corrosive sublimate as the most efficient preventive of the dry rot.

DUCAT, a coin current in Germany, and other countries abroad. In Germany, Italy, and Holland, it is of the value of about 9s. 3d.; the ducat of Naples is 8s. 4d.; that of Florence or Leghorn 5s. 4d.; the gold ducat of Portugal is 6l. 15s.

DUCATOON, a silver coin likewise, frequent in several parts of Europe; its value is 5s 5d.

DUCK. See Anas.

DUCT, *ductus*, in general, denotes any tube or canal.

DUCTILITY, that property or texture of bodies, which renders it practicable to draw them out in length, while their thickness is diminished, without any actual fracture of their parts. This term is almost exclusively applied to metals.

Most authors confound the words malleability, laminability, and ductility, together, and use them in a loose indiscriminate manner; but they are very different. Malleability is the property of a body which enlarges one or two of its three dimensions, by a blow or pressure very suddenly applied. Laminability belongs to bodies extensible in dimension by a gradually applied pressure: and ductility is properly to be attributed to such bodies as can be rendered longer and thinner by drawing them through a hole of less area than the transverse section of the bodies so drawn.

DUEL, a single combat, at a time and

place appointed, in consequence of a challenge. This custom came originally from the northern nations, among whom it was usual to decide all their controversies by arms. Both the accuser and accused gave pledges to the judges on their respective behalf; and the custom prevailed so far amongst the Germans, Danes, and Franks, that none were excused from it but women, sick people, cripples, and such as were under 21 years of age, or above 60. Even ecclesiastics, priests, and monks, were obliged to find champions to fight in their stead.

Duel, at present is used for a single combat on some private quarrel, and must be premeditated, otherwise it is called a rencounter. If a person be killed in a duel both the principals and seconds are guilty of murder, whether the seconds engage or not. It is also a very high offence to challenge a person either by word or letter, or to be the messenger of a challenge.

DUETT, in music, a composition written for two voices or instruments, with or without a bass and accompaniments.

DUKE is either the title of a sovereign prince, as the Duke of Savoy, Parma, &c. the Grand Duke of Tuscany, Muscovy, &c. or it is the title of honour and nobility next below princes.

DULCIMER, a musical instrument, strung with about fifty wires cast over a bridge at each end. It is performed upon by striking the wires with little iron rods.

DUMBNESS, the privation of the faculty of speech. The most general, or rather the sole cause of dumbness, is the want of the sense of hearing. The use of language is originally acquired by imitating articulate sounds. From this source of intelligence deaf people are entirely excluded; they cannot acquire articulate sounds by the ear: unless, therefore, articulation be communicated to them by some other medium these unhappy people must for ever be deprived of the use of language: and as language is the principal source of knowledge, whoever has the misfortune to want the sense of hearing must remain in a state little superior to that of the brute creation. Deafness has in all ages been considered as such a total obstruction to speech or written language, that an attempt to teach the deaf to speak or read was uniformly regarded as impracticable, till Dr. Wallis, and some others, proved that although deaf people cannot learn to speak or read by the direction of the ear, there are other sources of imitation by which the same effect may be produced. The organs of hearing and of speech have little or no connexion. Persons deprived of the former generally possess the latter in such perfection that nothing further is necessary, in order to make them articulate, than to teach them how to use these organs. This, indeed, is no easy task; but experience shews that it is practicable. Mr. Thomas Braidwood, late of Edinburgh, was perhaps the first who ever brought this surprising art to any degree of perfection. He began with a single pupil in 1764, and since that period has taught great numbers of people born deaf to speak distinctly, to read, to write, to understand figures, the principles of religion and morality, &c.

In the year 1810, a Society for the education of deaf and dumb children was instituted in Edinburgh. The first teacher was Mr. John Braidwood, a member of the family which has done so much for the instruction of these interesting objects. This Society is now under the superintendence of Mr. Robert Kinniburgh. The pupils are all boarded in the society's house, where they are taught reading, writing, and arithmetic; and are carefully instructed in the principles of the Christian religion. No child is admitted under nine, or above fourteen years of age; and six years are required for completing their education.

DUPLE, among mathematicians, denotes the ratio of 2 to 1. Thus the ratio of 8 to 4 is duple, or as 2 to 1.

Sub-**Duple ratio** is just the reverse of the former, or as 1 to 2. Such is 4 to 8, or 6 to 12.

DUPLICATE, among lawyers, denotes a copy of any deed, writing, or account. It is also used for the second letters patent, granted by the lord chancellor in a case wherein he had before done the same. Also, a second letter written and sent to the same party and purpose as a former, for fear of the first's miscarrying, is called a duplicate.

Duplicate *proportion*, or *ratio*, is a compound of two ratios: thus, the duplicate ratio of a to b, is the ratio of a^2 to b^2, or of the square of a to the square of b.

In a series of geometrical proportionals, the first term to the third is said to be in a duplicate ratio of the first to the second: thus in 2, 4, 8, 16. &c. the ratio of 2 to 8 is duplicate of that of 2 to 4, or as the square of 2 to the square of 4. Duplicate ratio is therefore the proportion of squares, as triplicate is of cubes, &c. and the ratio of 2 to 8 is said to be compounded of that of 2 to 4, and of 4 to 8.

DUPLICATION, in general, signifies the doubling of any thing, or multiplying of it by 2: also the folding of any thing back again on itself.

DUPLICATURE, among anatomists, a term used to denote the folds of any membrane, or vessel: thus we say, the duplicatures of the intestines, peritonæum, &c. See Anatomy.

DUPONDIUS, in antiquity, the weight of two pounds; also a piece of money equal to two ases in value.

DURA *mater*, in anatomy, one of the membranes, which surround the brain.

DURATE′, in music, a term properly applicable to whatever offends the ear by its effect. The B natural, on account of its hardness, was formerly called B durate.

DURANTA, a genus of the angiospermia order, in the didynamia class of plants, and in the natural method ranking under the 40th order, personatæ. There are three species shrubs of South America.

DURESS, in law, is where a man is kept in prison, or restrained of his liberty, contrary to the order of law.

DURIO, a genus of the class and order polyadelphia polyandria. The calyx is five-cleft; corolla five-petalled: style one; stamina in five bodies; pome five-celled. There is one species, a tree of the East Indies.

DUROIA, in botany, a genus of the monogynia order, belonging to the hexandria class

of plants. There is one species, a tree of Surinam.

DUTY, in policy and commerce, signifies the impost laid on merchandizes at importation or exportation, commonly called the duties of customs; also the taxes of excise, stamp-duties, &c.

DWARF, in general, an appellation given to things greatly inferior in size to that which is usual in their several kinds; thus there are dwarfs of the human species, dwarf-dogs, dwarf-trees, &c.

DYEING. The art of dyeing consists in fixing upon cloths of various kinds any colour which may be required, in such a manner that they shall not be easily altered by those agents to which the cloth will most probably be exposed.

As there can be no cause by which any colouring matter can adhere to any cloth, except an attraction subsisting between the two substances, it must follow, that there will be few tinging matters capable of indelibly or strongly attaching themselves by simple application. Dyeing is therefore a chemical art.

The most remarkable general fact in the art of dyeing, consists in the different degrees of facility, with which animal and vegetable substances attract and retain colouring matter, or rather the degree of facility with which the dyer finds he can tinge them with any intended colour. The chief materials of stuff to be dyed are wool, silk, cotton, and linen, of which the former two are more easily dyed than the latter. This has been usually attributed to their greater attraction to the tinging matter.

Wool is naturally so much disposed to combine with colouring matter, that it requires but little preparation for the immediate processes of dyeing; nothing more being required than to cleanse it, by scouring, from a fatty substance, called the yolk, which is contained in the fleece. For this purpose an alkaline liquor is necessary; but as alkalis injure the texture of the wool, a very weak solution may be used. For if more alkali were present than is sufficient to convert the yolk into soap, it would attack the wool itself. Putrid urine is therefore generally used, as being cheap, and containing a volatile alkali, which, uniting with the grease, renders its soluble in water.

Silk, when taken from the cocoon, is covered with a kind of varnish, which, because it does not easily yield either to water or alcohol, is usually said to be soluble in neither. It is therefore usual to boil the silk with an alkali, to disengage this matter. Much care is necessary in this operation, because the silk itself is easily corroded or discoloured. Fine soap is commonly used, but even this is said to be detrimental; and the white China silk, which is supposed to be prepared without soap, has a lustre superior to that of Europe. Silk loses about one-fourth of its weight by being deprived of its varnish. See BLEACHING.

The intention of the previous preparations seems to be of two kinds. The first, to render the stuff or material to be dyed as clear as possible, in order that the aqueous fluid to be afterwards applied may be imbibed, and its contents adhere to the minute internal surfaces. The second is, that the stuff may be rendered whiter and more capable of reflecting the light, and consequently enabling the colouring matter to exhibit more brilliant tints.

Some of the preparations, however, though considered merely as preparative, do really constitute part of the dyeing processes themselves. In many instances a material is applied to the stuff, to which it adheres: and when another suitable material is applied, the result is some colour desired. Thus we might dye a piece of cotton black, by immersing it in ink; but the colour would be neither good nor durable, because the particles of precipitated matter, formed of the oxide of iron and acid of galls, are already concreted in masses too gross either to enter the cotton, or to adhere to it with any considerable degree of strength. But if the cotton be soaked in an infusion of galls, then dried, and afterward immersed in a solution of sulphate of iron, (or other ferruginous salt,) the acid of galls being every where diffused through the body of the cotton, will receive the particles of oxide of iron, at the very instant of their transition from the fluid, or dissolved to the precipitated or solid state; by which means a perfect covering of the black inky matter will be applied in close contact with the surface of the most minute fibres of the cotton. This dye will therefore not only be more intense, but likewise more adherent and durable.

The French dyers, and after them the English, have given the name of *mordant* to those substances which are previously applied to piece goods, in order that they may afterward take a required tinge or dye.

It is evident, that if the mordant be universally applied over the whole of a piece of goods, and this be afterward immersed in the dye, it will receive a tinge over all its surface; but if it be applied only in parts, the dye will strike in those parts only. The former process constitutes the art of dyeing, properly so called; and the latter, the art of printing woollens, cottons, or linens, called calico-printing.

In the art of printing piece goods, the mordant is usually mixed with gum or starch, and applied by means of blocks or wooden engravings in relief, or from copper plates, and the colours are brought out by immersion in vessels filled with suitable compositions. Dyers call the latter fluid the bath. The art of printing affords many processes, in which the effect of mordants, both simple and compound, is exhibited. The following is taken from Berthollet.

The mordant employed for linens, intended to receive different shades of red, is prepared by dissolving in eight pounds of hot water, three pounds of alum, and one pound of acetate of lead, in which two ounces of potash, and afterward two ounces of powdered chalk, are added.

In this mixture, the sulphuric acid combines with the lead of the acetate and falls down, because insoluble, while the argillaceous earth of the alum unites with the acetic acid disengaged from the acetate of lead. The mordant therefore consists of an argillaceous acetic salt, and the small quantities of alkali and chalk serve to neutralize any disengaged acid which might be contained in the liquid.

Several advantages are obtained by thus changing the acid of the alum. First, the argillaceous earth is more easily disengaged from the acetic acid, in the subsequent processes, than it would have been from the sulphuric. Secondly, this weak acid does less harm when it comes to be disengaged by depriving it of its earth. And thirdly, the acetate of alumina not being crystallizable like the sulphate, does not separate or curdle by drying on the face of the blocks for printing, when it is mixed with gum or starch.

When the design has been impressed by transferring the mordant from the face of the wooden blocks to the cloth, it is then put into a bath of madder, with proper attention that the whole shall be equally exposed to this fluid. Here the piece becomes of a red colour, but deeper in those places where the mordant was applied. For some of the argillaceous earth had before quitted the acetic acid, to combine with the cloth; and this serves as an intermedium to fix the colouring matter of the madder, in the same manner as the acid of galls, in the former instance, fixed the particles of oxide of iron. With the piece in this state, the calico-printer has only therefore to avail himself of the difference between a fixed and a fugitive colour. He therefore boils the piece with bran, and spreads it on the grass. The fecula of the bran takes up part of the colour, and the action of the sun and air renders more of it combinable with the same substance.

In other cases the elective attraction of the stuff to be dyed has a more marked agency. A very common mordant for woollens is made by dissolving alum and tartar together; neither of which is decomposed, but may be recovered by crystallization upon evaporating the liquor. Wool is found to be capable of decomposing a solution of alum, and combining with its earth; but it seems as if the presence of disengaged sulphuric acid served to injure the wool which is rendered harsh by this method of treatment, though cottons and linens are not, which have less attraction for the earth. Wool also decomposes the alum, in a mixture of alum and tartar; but in this case there can be no disengagement of sulphuric acid, as it is immediately neutralized by the alkali of the tartar.

Metallic oxides have so great an attraction for many colouring substances, that they quit the acids in which they were dissolved, and are precipitated in combination with them. These oxides are also found by experiment to be strongly disposed to combine with animal substances; whence in many instances they serve as mordants, or the medium of union between the colouring particles and animal bodies.

The colours which the compounds of metallic oxides and colouring particles assume, then, are the product of the colour peculiar to the colouring particles, and of that peculiar to the metallic oxide.

The following are the dye-stuffs used by the calico-printers for producing fast colours. The mordants are thickened with gum, or calcined starch, and applied with the block, roller, plates, or pencil.

1. *Black.* The cloth is impregnated with acetate of iron (iron liquor,) and dyed in a bath of madder and logwood.

2. *Purple.* The preceding mordant of iron, diluted; with the same dying bath.

3. *Crimson.* The mordant for purple, united with a portion of acetate of alumina, or red mordant, and the above bath.

4. *Red.* Acetate of alumina is the mordant, (see ALUMINA,) and madder is the dye-stuff.

Pale red of different shades. The preceding mordant diluted with water, and a weak madder bath.

6. *Brown* or *Pompadour.* A mixed mordant, containing a somewhat larger proportion of the red than of the black; and the dye of madder.

7. *Orange.* The red mordant; and a bath first of madder, and then of quercitron.

8. *Yellow.* A strong red mordant; and the quercitron bath, whose temperature should be considerably under the boiling point of water.

9. *Blue.* Indigo, rendered soluble and greenish-yellow coloured, by potash and orpiment. It recovers its blue colour by exposure to air, and thereby also fixes firmly on the cloth. An indigo vat is also made, with that blue substance diffused in water with quicklime and copperas. These substances are supposed to deoxidize indigo, and at the same time to render it soluble.

Golden-dye. The cloth is immersed alternately in a solution of copperas and lime water. The protoxide of iron precipitated on the fibre, soon passes, by absorption of atmospherical oxygen, into the golden-coloured deutoxide.

Buff. The preceding substances, in a more dilute state.

Blue vat, in which white spots are left on blue ground of cloth, is made by applying to these points a paste composed of a solution of sulphate of copper and pipe-clay; and after they are dried, immersing it stretched on frames, for a definite number of minutes, in the yellowish-green vat, of one part of indigo, two of copperas, and two of lime, with water.

Green cloth dyed blue and well washed, is imbued with the aluminous acetate, dried and subjected to the quercitron bath.

In the above cases the cloth, after receiving the mordant paste, is dried, and put through a mixture of cow dung and warm water. It is then put into the dyeing vat or copper.

Fugitive Colours.

All the above colours are given by making decoctions of the different colouring woods; and receive the slight degree of fixity they possess, as well as great brilliancy, in consequence of their combination or admixture with the nitro muriate of tin.

1. *Red* is frequently made from Brazil and peach wood.

2. *Black.* A strong extract of galls and deuto-nitrate of iron.

3. *Purple.* Extract of logwood and the deuto-nitrate.

4. *Yellow.* Extract of quercitron bark, or French berries, and the tin solution.

5. *Blue.* Prussian blue and solution of tin.

Fugitive colours are thickened with gum tragacanth, which leaves the cloth in a softer

state than gum-senegal; the goods being sometimes sent to market without being washed. For farther information the reader is referred to the excellent treatise on dyeing by Berthollet, edited by Dr. Ure, from whose Dictionary of Chemistry the above article is copied.

DYNASTY, among ancient historians, signifies a race or succession of kings of the same line or family: such were the dynasties of Egypt. The Egyptians reckon thirty dynasties within the space of 36,525 years; but the generality of chronologers look upon them as fabulous. And it is very certain that these dynasties are not continually successive, but collateral.

DYSENTERY. See MEDICINE.

DYSOREXY, among physicians, denotes a want of appetite, proceeding from a weakly stomach.

DYSPEPSY, a difficulty of digestion, for which physicians prescribe bitters.

DYSPNOEA, a difficulty of breathing, usually called asthma.

DYSURY, in medicine, a difficulty of making urine, attended with a sensation of heat and pain. It is distinguished from a stranguary, as in the last, the urine is voided by only a drop, as it were, at a time, but, however, with pain; and from an ischury, as in this disorder, there is an almost total suppression of urine.

DYTISCUS, *the water-beetle*, in zoology, a genus of insects of the order of coleoptera. There are 23 species, distinguished by their antennæ, the various colours of the elytra, &c. The larvæ are often met with in water. They are oblong, and have six scaly feet. The body consists of eleven segments. The head is large, with four filiform antennæ, and a strong pair of jaws. The last segments of the body have rows of hairs on the sides; and the abdomen is terminated by two spines. The larvæ are frequently of a greenish variegated brown; they are lively, and extremely voracious: devouring other water-insects, and even each other. The perfect insect is little inferior to its larvæ in voraciousness, but it can only exercise its cruelty on the larvæ; the perfect insects, like himself, being sheltered by a scaly cuirass. This creature must be touched cautiously: for, besides its power of giving a severe gripe with its jaws, it has a long sharp spine, which it drives into the fingers. The eggs of the dytisci are large, and inclosed in a silky duskish cod.

The perfect insects are common in stagnated waters which they quit in the evening to fly about. They swim with great agility, making use of their hinder legs as oars.

E.

E, The fifth letter of the alphabet, and second vowel, has different pronunciations in most languages. The Greeks have their eta η, and epsilon ε, or long and short e. The French have their *e* open pronounced much like our *a*, in the words *face* and *make;* their *e* masculine, pronounced not unlike our *y* at the end of words, as *libertee, liberty;* their *e* feminine, or mute, and their *e* before an *m* or *n*, which sounds like our *a* in the word *war:* these are all exemplified in the words *empechee* or *enfermee.* In English there are three kinds of *e, viz.* the open or long *e*, as in the words *bear, wear;* the close or short *e*, as in *wet, kept*; and mute *e*, which serves to lengthen the syllable, as in *love, came,* &c.

As a numeral, E stands for 250. In music it denotes the tone *e-la-mi.* In the calendar it is the fifth of the dominical letters. And in sea-charts it distinguishes all the easterly points; thus E. alone denotes, E. by S. and E. by N. east by south, and east by north.

EAGLE. See FALCO.

EAGLE, in astronomy. See AQUILA.

EAGLE, in heraldry, is accounted one of the most noble bearings. They are generally borne with their wings and tails expanded. This posture is best fitted to fill up the escutcheon.

EAR, in anatomy, the organ of hearing. See ANATOMY.

EAR, in music, implies, that sensible, clear, and true perception of musical sounds, by which we are offended at dissonance, and pleased with harmony. To have an ear, which is a common phrase is to be capable of distinguishing the true intonation from the false, to be sensible of metrical precision, and to feel all the nicer changes of artificial combination.

EAR-*wig.* See FORFICULA.

EARING, in the sea-language, is that part of the bolt-rope which, at the four corners of the sail, is left open, in the shape of a ring. The two uppermost parts are put over the ends of the yard arms, and thus the sail is made fast to the yard; and into the lowermost earings, the sheets and tacks are seized or bent at the clew.

EARL, a British title of nobility, next below a marquis, and above a viscount. Earls were anciently called *comites,* because they were wont *comitari regem,* to wait upon the king for council and advice.

EARTH. See ASTRONOMY and GEOLOGY.

EARTHQUAKE. See PHYSICAL GEOGRAPHY.

EASTER, a festival of the Christian church, observed in memory of our Saviour's resurrection.

In the primitive ages of the church, there were very great disputes about the particular time when this festival was to be kept. The Asiatic churches kept their Easter upon the very same day the Jews observed their passover; and others, on the first Sunday after the first full moon in the new year. This controversy was determined in the council of Nice, when it was ordained that Easter should be kept upon one and the same day, which should always be a Sunday, in all Christian churches throughout the world.

EAU *de luce*, a fragrant liquor, possessing and retaining a milky opacity, made chiefly of mastic dissolved in alcohol, to which are added, elemi and aqua ammoniæ puræ.

EBENUS, the ebony-tree, a genus of the decandria order, in the diadelphia class of plants, and in the natural method ranking under the 32d order, papilionaceæ. The segments of the calyx are the length of the corolla, and the latter has scarcely any alæ. There is one rough seed. There are two species.

The cretica is a native of the island of Crete, and some others in the Archipelago. It rises with a shrubby stalk, three or four feet high, which puts out several side branches with hoary leaves at each joint, composed of five narrow spear-shaped lobes, which join at their tails to the foot-stalk, and spread out like the fingers of a hand. The branches are terminated by thick spikes of purple flowers.

The pinnata is a biennial, a native of the Levant. These plants constitute the genus ebenus of botanists; but there is reason to think that the wood of this name is produced from several different trees.

ECHENEIS, the remora, in ichthyology, a genus belonging to the order of thoracici. The head is fat, naked, depressed, and marked with a number of transverse ridges; it has ten rays in the branchiostege membrane; and the body is naked. There are two species, viz.

1. The remora or sucking-fish, with a forked tail, and 18 striæ on the head. It is found in the Indian Ocean.

2. The neucrates, with an undivided tail, and 16 striæ on the head. It is likewise a native of the Indian Ocean.

These fishes are often found adhering so strongly to the sides of sharks and other great fish, by means of the structure of the head, as to be got off with difficulty.

ECHINOPHORA, in botany, a genus of the digynia order, in the pentandria class of plants; and in the natural method ranking under the 45th order, umbellatæ. There are two species, herbaceous plants of the south of Europe.

ECHINOPS, a genus of the polygamia segregatæ order, in the syngenesia class of plants, and in the natural method ranking under the 49th order, compositæ. There are five species, annual and perennial plants, one of which is well known under the name of globe thistle.

ECHINORYNCHUS, a genus of the vermes intestina; body round, proboscis cylindrical, retractile, and crowned with hooked prickles. They are found fixed firmly to the viscera of various animals, generally the intestines. There are 48 species.

ECHINUS, in zoology, the sea hedgehog, a genus of insects belonging to the order of vermes mollusca. The species are, 1. The esculentus, or eatable echinus, is of an hemispherical form, covered with sharp spines, commonly of a violet colour; moveable; adherent to small tubercles. These are their instruments of motion by which they change their place. This species is taken in dredging, and often lodges in cavities of rocks. 2. The lacunosus, is of an oval depressed form; on the top it is of a purple colour, the lower side studded, and divided by two smooth spaces; length, four inches. It is covered with bristles. There are 15 other species.

ECHITES, in botany, a genus of the monogynia order, in the pentandria class of plants, and in the natural method ranking under the 30th order, contortæ. There are 22 species, shrubs, chiefly of South America.

ECHIUM, *viper's bugloss*, a genus of the monogynia order, in the pentandria class of plants, and in the natural method ranking under the 41st order, asperifoliæ. There are 21 species, three of which are natives of Britain. None of them have any remarkable property, except that the flowers of one species (the vulgare) are very grateful to bees.

ECHO, a sound reflected, or reverberated from some body, and thence returned or repeated to the ear.

For an echo to be heard, the ear must be in the line of reflection; that the person who made the sound may hear the echo, it is necessary he should be in a perpendicular line to the place which reflects it. Those murmurs in the air, that are occasioned by the discharge of great guns, &c. are a kind of indefinite echoes, and are produced from the vaporous particles suspended in the atmosphere, which resist the undulations of sound, and reverberate them to the ear.

There can be no echo, unless the direct and reflex sounds follow one another at a sufficient distance of time; for if the reflex sound arrives at the ear before the impression of the direct sound ceases, the sound will not be doubled, but only rendered more intense.

Echoing bodies may be so contrived and placed, that reflecting the sound from one to the other, a multiple echo, or many echoes, shall arise. At Rosneath, near Glasgow, in Scotland, there is an echo that repeats a tune played with a trumpet three times completely and distinctly. At the sepulchre of Metella, wife of Crassus, there was an echo, which repeated what a man said five times. Authors mention a tower at Cyzicus, where the echo repeated seven times. There is an echo at Brussels that answers fifteen times.

One of the finest echoes we read of is that mentioned by Barthius, in his notes on Statius's Thebais, lib. vi. ver. 30, which repeated the words a man uttered 17 times. This was on the banks of the Naha, between Coblentz and Bingen.

Echo, in architecture, a term applied to certain kinds of vaults and arches, most commonly of elliptical and parabolical figures, used to redouble sounds, and produce artificial echoes.

Echo, in poetry, a kind of composition wherein the last words or syllables of each verse contain some meaning, which being repeated apart, answers to some question or other matter contained in the verse, as in this beautiful one from Virgil:

Crudelis mater magis, an puer improbus ille?
Improbus ille puer, crudelis tu quoque mater.

ECHOMETER, among musicians, a kind of scale or rule, with several lines thereon, serving to measure the duration and length of sounds, and to find their intervals and ratios.

ECLECTICS, ancient philosophers, who, without attaching themselves to any particular sect, selected whatever appeared to them the best and most rational, from each.

ECLIPSE, the deprivation of the light of

the sun, or of some heavenly body, by the interposition of another heavenly body between our sight and it. See Astronomy.

ECLIPTA, a genus of the class and order syngenesia polygamia superflua. The recept. is chaffy down none; corollets of the disk four-cleft. There are five species, herbaceous plants of the East and West Indies.

ECLIPTIC, in astronomy, a great circle of the sphere, supposed to be drawn through the middle of the zodiac, making an angle with the equinoctial of about 23° 30′, which is the sun's greatest declination; or, more strictly speaking, it is that path or way among the fixed stars that the earth appears to describe to an eye placed in the sun.

Ecliptic, *obliquity of*, is the angle which its plane makes with that of the equinoctial. The inclination of the equator to the ecliptic is measured by the arch of a great circle intercepted between their poles, which was taken with very great accuracy by Dr. Maskelyne, in the year 1769, and found to be 23° 28′ 10″, or 23° .46944. It was formerly found by Dr. Bradley to be 23° 28′ 30″, who supposed that there was a gradual approach of the ecliptic to the equinoctial at the rate of 1′ in 100 years. The mean obliquity of the ecliptic is augmented by 9″, when the moon's ascending node is in the vernal equinox. It is on the contrary, diminished 9″, when the node is in the autumnal equinox, and it is equal to the mean when the node is in the colure of the solstices. This change of the inclination of the earth's axis to the plane of the ecliptic was called the nutation of the axis by Sir Isaac Newton.

Ecliptic, in geography, a great circle on the terrestrial globe, not only answering to, but falling within the plane of the celestial ecliptic. See Globe.

ECLOGUE, in poetry, a kind of pastoral composition, or a small elegant poem, in a natural simple style. See Poetry.

ECONOMY, *political*. Political economy is the science which treats of the wealth of nations. Its object is to ascertain, in the first place, wherein wealth consists, and then to explain the causes of its production, and the principles on which it is distributed through the different orders of society. It likewise endeavours to point out the tendency which any political regulations may have to favour or to injure the productions or most advantageous distribution of wealth. Such is its peculiar object, and consequently though writers on political economy may frequently treat on the more important topics of national security, freedom and happiness, these are then passing the strict limits of their science.

Political economy, in some of its branches, has engaged the attention of speculative men in all ages; but it is only in very recent times that the truths it exhibits have been collected, arranged, and demonstrated with such precision, as to entitle it to the name and dignity of a science.

The greatest writer that has yet appeared on this subject is Dr. Adam Smith, whose well known work on the Wealth of Nations has raised him to the high rank among politicians which Sir Isaac Newton holds among astronomers.

EFFERVESCENCE is the commotion produced in fluids by some part of the mass suddenly taking the elastic form, and escaping in numerous bubbles.

EFFLORESCENCE is the effect which takes place when bodies spontaneously become converted into a dry powder. It is almost always occasioned by the loss of the water of crystallization in saline bodies.

EFFLUVIUM, in physiology, a term much used by philosophers and physicians, to express the minute particles which exhale from most, if not all, terrestrial bodies in form of insensible vapours. Sometimes, indeed, these effluvia become visible, and are seen ascending in form of smoke; constituting what, in animals and plants, makes the matter of perspiration.

EGGS. The eggs of hens, and of birds in general, are composed of several distinct substances. 1. The shell or external coating, which is composed of carbonate of lime .72, phosphate of lime .2, gelatine .3. The remaining .23 are perhaps water. 2. A thin white and strong membrane, possessing the usual characters of animal substances. 3. The white of the egg, for which see Albumen. 4. The yolk, which appears to consist of an oil of the nature of fat oils, united with a portion of serous matter, sufficient to render it diffusible in cold water, in the form of an emulsion, and concrescible by heat. Yolk of egg is used as the medium for rendering resins and oils diffusible in water.

EHRETIA, in botany, a genus of the monogynia order, in the pentandria class of plants, and in the natural method ranking under the 41st order, asperifoliæ. There are five species, trees and shrubs of the West Indies.

EHRHARTA, a genus of the monogynia order, in the hexandria class of plants. There are five species; grasses of the Cape.

EJECTMENT. An ejectment is a mixed action, by which a lessee for years, when ousted, may recover his term and damages; it is real in respect of the lands, but personal in respect of the damages.

EKEBERGIA, a genus of the class and order decandria monogynia. The calyx is four-parted; petals four; berry contains five oblong seeds. There is one species, a tree of the Cape.

ELÆAGNUS, *oleaster*, or *wild olive*, a genus of the monogynia order, in the tetrandria class of plants, and in the natural method ranking under the 16th order, calycifloræ There are nine species. The most remarkable are, 1. orientalis, or eastern broad-leaved olive, with a large fruit, is a native of the Levant, and some parts of Germany. 2. The angustifolia, without thorns, is that kind commonly preserved in the gardens of this country. The leaves are more than three inches long, and have a shining appearance like satin. The flowers come out at the footstalks of the leaves, sometimes singly, at other times two, and sometimes three, at the same place. The outside of the empalement is silvery and studded; the inside of a pale yellow, and having a very strong scent. 3. The latifolia, with oval leaves, is a native of Ceylon, and some other parts of India.

ELÆIS, a genus belonging to the natural order of palmæ. There is one species, from the fruit of which, the negroes extract the famous palm oil.

ELÆOCARPUS, a genus of the monogynia

order, in the polyandria class of plants, and in the natural method ranking with those of which the order is doubtful. There are six species, trees of the East Indies. One of them, the copaliferus, yields the resin so useful as a varnish, called gum copal.

ELÆODENDRUM, olive wood, a genus of the pentandria monogynia class and order. There are two species, trees of Africa.

ELASTICITY, or *elastic force*, that property of bodies with which they restore themselves to their former figure, after any external pressure; being the same with what is called springiness.

Elasticity is increased by augmenting the density of a body: thus metals are rendered more elastic by being beaten by a hammer. Steel is more elastic when tempered, and its density is increased in the ratio of 7809 to 7738.

Elasticity is sometimes increased by cold; thus the range of a cannon-ball is said to be greater when the cannon is cold, than when heated; and the string of a violin is inflected, and recovers its situation, with less force in hot than in cold weather.

Metal fibres, and thin steel laminæ, exhibit no elasticity, unless stretched to a certain degree, and inflected by a certain force; as appears from lax cords, which, if a little stretched and removed from their natural state, discover no tendency to return to it; and when the inflection of a fibre is very great, the influence of elasticity seems to be in some cases annihilated, as appears by the fibres of wood, which, inflected to a certain degree, remain quiescent, and have no tendency to recover their former situation. The limits where the elastic power begins, or where it terminates, are unknown.

ELATE, a genus belonging to the natural order of palmæ. There is one species, a native of the East Indies, which grows to the height of 14 feet. The natives chew the nut in the same manner as the leaf of the betel.

ELATER, in zoology, a genus of insects, belonging to the order of coleoptera. By means of a spring under the thorax, the animal, when turned upon its back, contrives to leap up into the air, and so turn itself. In the state of larvæ it inhabits the trunks of decayed trees, and is there transformed.

ELATERIUM, a genus of the monandria order, in the monœcia class of plants; and in the natural method ranking under the 34th order, cucurbitaceæ. There are two species, natives of America.

ELATINE, a genus of the tetragynia order, in the octandria class of plants; and in the natural method ranking under the 15th order, inundatæ. There are two species, annual aquatics of Europe.

ELECTION, is where a person has by law two remedies, and is compelled to declare which he will abide by: thus a creditor, in cases of bankruptcy, may either prove his debt under the commission, or proceed at law; but in this case he is compelled to make his election.

Election *of members of parliament*. Qualification of the candidates. No member shall sit or vote in either house of parliament unless he be 21 years of age. 4 Inst. 47.

They must not be aliens-born; they must not be any of the twelve judges because they sit in the house of lords. But persons who have judicial places in the other courts, ecclesiastical or civil, are eligible. Nor of the clergy; the reason assigned for which is, that they might sit in the convocation. Nor persons attainted of treason or felony, for they are unfit to sit any where.

ELECTIVE *attraction*. See Attraction and Chemistry.

ELECTRICITY. This term which is derived from the word *electron*, the Greek name of amber, is now generally applied to that science which investigates the attractions and repulsions, the emission of light, and explosions, which are produced, not only by the friction of vitreous, resinous, and metallic surfaces, but by the heating, cooling, evaporation, and mutual contact of a vast number of bodies.

It is common for writers on the subject of electricity to give at least a sketch of the history of the science; but as we are necessarily compelled to study the utmost brevity in a work like the present, we must be excused entering on such a detail; simply remarking, that the electrical phenomena constitute the first physical fact recorded in the history of science.

Neither shall we here attempt a discussion on the nature of the electric substance; since, at the present hour, the most rational theories before the public are at least but hypothetical; although it must be allowed, that the means of investigation which are now at the command of scientific men; the persevering diligence with which those means are employed; and the success which seems to crown their labours, unite in announcing the near approach of some discovery that will effect what has baffled the ingenuity of philosophers for nearly two thousand years.

The first thing that demands attention on this subject is the proper management of the electrical machine. Although it must require considerable practice to enable a person to perform electrical experiments with neatness and success, yet the path to this very desirable end may, we conceive, be much shortened by a strict attention to suitable directions.

OF ELECTRICAL MACHINES.

There are two forms of the electrical machine, viz. the cylindrical, which is the most common, and the cheapest form in which the machine can be made; and the plate machine, which has decidedly the advantage of the cylindrical in point of elegance, and also in power, although some prefer the latter on account of the facility which it affords for producing negative electricity.

Fig. 1. Plate XIV. represents the cylindrical machine in the simplest and most convenient form, in which it can be constructed. A A A A is the board on which the supporters and pillars are erected, and by which the machine is made fast with cramps to the table. B B B B are two wooden pillars or supporters having their lower ends mortised into the board A A A A, and in the upper ends of these the axis of the glass cylinder C C C C turns. D D is the winch by which the cylinder is turned on its axis. E E is a piece of wood, a part of which slides into a grove under the board A A A A, and is made fast by the

thumb-screw *f*. G G is a glass pillar, which is fixed to the wood E E, and supports what is called the negative conductor and rubber H H. I I is another piece of wood, which slides in a similar groove under the board A A A A, and is made fast by the thumb-screw *j*. K K is a glass pillar fixed into the wood I I, and supports the prime conductor L L; to this conductor a number of metallic points are attached, to collect the fluid from the surface of the cylinder, and lead it to the prime conductor. M M is a rod of brass inserted in the prime conductor, having a joint by which it may be raised or lowered, to suit the height of the apparatus; this rod is a most useful appendage to the prime conductor. To the upper part of the rubber a piece of black silk is attached, which proceeds from thence over the top of the cylinder, to within about half an inch of the points of the wires inserted in the prime conductor; by which means the fluid that is brought into action by the attrition of the cylinder and rubber is prevented from being dissipated in the air, and carried round with the cylinder to the prime conductor. The action of the silk on the cylinder tends very much to increase the excitation of the machine, as may be seen by removing the cushion a little back from the cylinder, and leaving the silk to act upon it alone, in which case the excitation will often be found to be scarcely less than when the rubber is also in contact with the cylinder.

The plate electrical machine, represented fig. 2. Plate XIV, was invented by Dr. Ingenhouz, and has been perfected by Mr. Cuthbertson. It consists of a circular plate of glass, turning on an axis which passes through its centre; it is rubbed by two pairs of cushions fixed at opposite points of its periphery by elastic frames of thin mahogany, which are made to press the glass-plate with the required degree of force, by means of regulating screws. A brass conductor, supported by glass, is fixed to the frame of the machine, with its branched extremities opposite each other, and near the extreme diameter of the plate, in a direction at right angles with the vertical line of the opposite cushions. The branched extremities of the conductor are furnished with pointed wires, which serve to collect the electricity from the surface of the excited plate. These machines are sometimes fitted up with two plates, which are fixed on the same axis, by which the power of two machines is combined in one, although the labour of turning such a machine is thereby augmented considerably; where a copious flow of electricity is required, two of these double plate machines may be used, or a single plate of large diameter. The motion of the machine must always be in the direction of the silk flaps that proceed from the rubbers.

The cylindrical machine however being at present in more common use than the plate machine, it is hoped the following remarks may be of use to those who possess such an instrument, and particularly to such as may be disposed to provide themselves with it for the sake of economy. A cylindrical electrical machine ought never to be less than ten inches in diameter; there are cylinders of six, seven, eight, and nine inches diameter, often neatly mounted, and sold by the philosophical instrument makers, but they are of no manner of use for the purpose of experiment, and serve only as a kind of philosophical toy, for the amusement of children, and that too on a very narrow scale. To construct such machines, therefore, is an absolute waste of the materials. With a cylinder of ten inches, properly managed, a tolerable exhibition may be made, but the most convenient size is from twelve to sixteen, the length of the cylinder being in proportion.

The most powerful excitation of the machine is produced as follows. Let the machine be placed within the influence of a good fire, but not so near as to injure any of its parts by the action of the heat. With a flat round pointed knife spread a little amalgam evenly along the cushion, and return it to its place: turn the cylinder a few times round; then take off the cushion, and observe carefully those parts on its surface that have not been touched by the cylinder while revolving; on these parts put a little more amalgam, and repeat the process of turning the cylinder, and supplying the defective parts with amalgam, till every point of that part of the surface of the cushion which presses on the cylinder appears to be properly supplied with amalgam. Take now a piece of leather about five or six inches square, and spread over one side of it a quantity of amalgam; throw back the silk flap, and, turning the machine gently round, apply the amalgamed side of the leather to the cylinder, for the space of two minutes or more, as circumstances may require, during which time the excitation will be observed to increase rapidly. The cylinder must next be wiped perfectly clean with an old silk handkerchief, and afterwards with a soft dry linen cloth. Let the cushion be again removed; and the amalgam which appears above and below the line of contact with the cylinder carefully scraped off, the silk flap wiped, with the linen cloth, and the whole returned to its place and made fast. If now the cylinder be turned slowly round, streams of the electric fluid will be seen rushing from the silk flap round the lower part of the cylinder, attended with a hissing and snapping noise, while large brushes of the same, of several inches in length may be observed flying off from the lower edge of the silk into the surrounding air. The machine is now fit for use, and may be fastened to the table, after which the whole of its parts are to be well wiped with a warm and dry linen cloth to free them from dust.

The operator however must not expect this high and rich state of excitation to be of long duration. The cylinder will soon cool; dust will be attracted by the action of the machine; and the moisture produced in the air of the room by the breaths of his audience, will, by their united effects render all his efforts to produce a copious supply of electricity entirely fruitless.

To remedy this defect, which gentlemen who deliver public lectures on electricity have often found to be a grievous one, provide a box of thin plate iron, ten or twelve inches long, four inches wide, and one inch and a half in depth, with a lid to fit very easily over it. In this box a piece of bar iron of about six inches in length, three in breadth, and half an inch in thickness, after being heated in the fire to a dull red heat is to be placed, the lid of the box

put on, and the whole, on a suitable iron stand, placed under the cylinder, on the board of the machine in a longitudinal direction. The radiation of heat from the iron will effectually preserve the equality of the temperature of the surrounding air for a considerable length of time, and indeed, for any length of time required, since, by employing two bars of iron, the one may be kept in the fire while the other is in the box, and thus no other interruption in the course of the experiments will be necessary beyond what is occasioned by the changing of the irons. By this means the machine may be made to act in full vigour under the most disadvantageous circumstances. Whilst writing this article we have seen a proposal for remedying the difficulty we refer to, by placing a small spirit lamp under the rubber of the machine, and another under the conductor. This method may certainly, in some degree, prove beneficial; but it will be found to be in many respects inferior to the simple method here offered. In the first place, the radiation of heat will be neither so general nor so great; in the second place, the flame of a lamp or a candle absorbs the fluid; and in the third place, the *light*, which must necessarily be emitted from two spirit lamps, would prove highly detrimental to the effect of those experiments which require to be performed in darkness. To which may be added, the expense of the lamps, and the spirit to be consumed. Where a plate machine of large dimensions is used, this additional article will not be required; for the great thickness of the glass renders it capable of retaining the heat much longer than can be done by a thin cylinder; for which reason it must be obvious that if cylinders were made much stronger than they generally are, their action would be effectual for a greater length of time than it is. Opinion, however, runs in favour of thin cylinders, but the consistency of such opinion remains to be shewn. It is well known that the old globular machines, which were made of thick glass, when once put in a state of powerful excitation, retain that state much longer than the modern thin cylinder will do under the same circumstances.

The best *amalgam* for electrical machines is thus made. Melt in an iron ladle two ounces of zinc with one ounce of tin, and while this mixture is in a fluid state, pour into it six ounces of mercury; let the whole be then put into an iron or wooden box, and agitated until it be quite cold. In must then be reduced to fine powder in a mortar, and mixed with sweet hog's lard to the consistence of thick paste. This part of the process need not be performed till the amalgam is wanted for use.

OF ELECTRICAL APPARATUS.

The various articles of apparatus necessary for the exhibition of the most usual experiments in electricity, are insulating stands, or supports of various forms, wires, fine brass chains, a few spare brass balls of different sizes that may be screwed on wires when wanted; a few pith balls, two or three glass tubes of about three quarters of an inch in diameter, and from three to five feet in length; a large stick of sealing-wax; and four or five coated jars of different sizes. Electrical apparatus may be multiplied to a very great extent; but the electrician who understands the construction of his apparatus can readily combine even a small portion of it in so many different ways that he may save himself from an enormous expense by the exercise of his own ingenuity. No person, indeed, who is not competent to handle electrical apparatus with the skill of a workman, ought ever to venture beyond the most common-place experiments, at least where expense is any object.

The application of the apparatus to the purpose of experiment will best explain the nature of its different parts; and, in adopting this plan, we shall be enabled to give such an arranged view of the chief properties of the electrical fluid as may be of service in aiding the inexperienced electrician in making an orderly display, instead of a series of experiments which have no regular connection, and in which, sometimes one property, and sometimes another, is illustrated.

Attraction and Repulsion.

1. Excite a glass tube, by rubbing it for a few seconds with a silk handkerchief that has a little amalgam spread upon that part of it which touches the tube; hold the excited tube over some small bits of leaf gold, placed on a metallic plate, or on a smooth table, and they will be immediately attracted by the tube, between which and the table they may be made to pass up and down with great rapidity for a considerable time.

2. Bring an excited tube near a small downy feather; the feather will be attracted by the tube, and will cling to it till it be saturated with the fluid; it will then be repelled, and may be kept floating about in the room, by occasionally approaching it with the tube, from which it will recede, so long as it retains the electricity which it carried off from the tube.

3. By a fine flaxen thread attach a large downy feather to the prime conductor of the machine; turn the cylinder gently round, and the fibres of the feather will repel each other; approach it with a brass ball, or with the closed hand, and it will endeavour to turn itself towards the ball or hand, but present a pointed wire to it, and it will instantly shrink from it back on the conductor, as if animated, which arises from its being suddenly deprived of its electricity by the point.

4. This experiment may be varied by inserting the brass stem of Fig. 3. Plate XIV. into one of the holes in the prime conductor. The action of the machine will cause the hairs on the head to diverge from each other, and to stand on end.

5. By means of a pointed wire projecting a few inches from the prime conductor, electrify the inside of a large dry glass tumbler, then place it over about a dozen of small pith balls on a table, and the balls will be alternately attracted and repelled, at first with great rapidity, but the motion will become gradually more languid until it entirely cease. An instrument is constructed on purpose for this experiment, by which the dancing of the balls may be kept up for any length of time, as it may be connected with the conductor. See Fig. 4.

6. Suspend from the conductor, by a brass chain, a circular plate of copper, and reaching to within an inch and a half, or two inches of the table. Directly under this plate, place another of the same form and a little larger on

the table. Turn the machine, and the fluid will pass from the upper to the lower plate. If now small figures fancifully cut out of pasteboard, or pith of elder, be introduced between the plates, they will dance about with apparent vivacity, and sometimes appear to course round the edge of the lower plate. See Fig. 5.

7. *The electrical bells* furnish a pleasing illustration of the attraction and repulsion of the electric matter. They are variously constructed, but the form exhibited Fig. 6, is the simplest. The two outer bells are suspended by brass chains; the middle bell and the two clappers by fine silk threads. When the bells are attached to the conductor, and the machine is turned very slowly, the fluid will pass along the chains to the two outer bells, but will not pass along the silk to the clappers and middle bell. Thus the outer bells being charged with an extra quantity of electricity, will attract the clappers, but the moment they touch the bells, they become charged, and are repelled with such force as to cause them to strike against the middle bell, on which they deposit their electricity, and are again attracted. By this means a constant ringing is kept up while the machine is turned. From the inside of the middle bell a brass chain passes to the table for the purpose of conveying away the fluid deposited on it by the clappers.

Effect of Points on the Electric Fluid.

The effect of pointed conductors on the electric fluid may be illustrated by a great variety of pleasing experiments. The following are perhaps the most striking. 1. The *electrical fly.* Fig. 7. represents a light brass fly consisting of fine wires proceeding from a common centre, and having their pointed ends turned back at right angles, and all in the same direction. If this fly be poised on its centre on a pointed wire inserted in the prime conductor, and the machine be put in action, a stream of fluid will issue from each point, and produce a loco-motion in the fly, propelling it in a direction contrary to that of the points: the points will of course appear luminous, and if the room be darkened, a beautiful circle of fire will be distinctly seen, formed by the revolution of the fly. On the same principle motion is communicated to, 2. *The Electrical Orrery.* This instrument is represented by Fig. 8. The ball S represents the sun, L the earth, and M the moon, connected by the wires *a c* and *b d*: *b* is the centre of gravity between the earth and moon.

These three balls and their connecting wires are supported on the sharp point of a wire A, which is inserted in a hole in the prime conductor, and must stand perfectly upright and steady; the earth and moon hanging on the sharp point of the wire *c a e*. From the side of each ball a short pointed wire projects horizontally, from which the fluid passes off in a stream when the machine is worked, and thus motion is given to the whole; the sun and earth moving round their common centre of gravity *a*; and the earth and moon round theirs at *b*. The weights of the balls may be so nicely adjusted that E and M will make *twelve* revolutions round *b*, in the time that S and E make *one* round *a*.

8. *The Electrical Inclined Plane.* This is a highly beautiful experiment, and satisfactorily shews that the electrical matter issuing from a number of points, possesses force sufficient to counteract the power of gravity in light bodies. Fig. 9 represents the inclined plane, where A is a board of mahogany 14 inches long, and 4 inches broad; B B B B are four glass pillars, three tenths of an inch in thickness, the length of the two longer is seven inches, and that of the two shorter is five inches.

From the longer to the shorter pillars, are stretched two fine brass wires, parallel to each other, and tightened by screws which pass through the brass balls which surmount the pillars. On these wires the axis of the fly C rests, the ends of which are formed like a small pulley, having a groove in them to prevent their slipping off the wires, and to guide the fly when in action. It is obvious that if the fly be placed on the upper part of the wires, it will roll down them by its own gravity; but when it has reached the bottom of the plane, if the upper end of the wires be connected with the machine while in action, the escape of the fluid from the points will cause it to roll very rapidly up the plane till it reach the top of it.

These experiments may be varied to a great extent, and models of corn-mills, water-pumps, astronomical clocks, &c., constructed of cork and paste-board, are readily put in action, by directing against their main wheels, a stream of electricity from a strong pointed wire inserted into the prime conductor.

Of the Leyden Jar.

The Leyden jar, or phial, is so called from the circumstance of its properties having been first observed at Leyden by M. Van Kleist, dean of the cathedral in Camin. It consists of a glass jar of any convenient size, having the outside and inside coated with tin foil, to within 2 or 3 inches of the top, and a brass wire, the upper part of which must terminate in a ball of the same metal, and the lower part in a fine chain, or a piece of fine wire, that it may touch the inside of the jar, passing through a lid of baked wood which fits into the mouth of the jar. This jar, as commonly used, is represented by Fig. 10. If a jar thus constructed be held by the lower part with the hand, and the knob be brought in contact with the prime conductor while the machine is in action it will become charged; and if a communication be then formed between its outside and inside coatings, by the other hand being brought to the knob, that sensation called the electrical shock will be felt, and the jar will thus be discharged. But when it is required to pass the charge of the jar through any particular substance, the jointed discharging rod must be used, Fig. 11, which is mounted on a glass handle to prevent the dispersion of the fluid. Any number of these jars combined together, and having a communication formed between their exterior and interior coatings, is called an electrical battery. Fig. 1. Plate XV. For experiments that do not require great power, two or three jars are sometimes connected together by wires; and this is often more convenient than charging the battery; but where great power is required, the battery is indispensable to success. In using a single jar it is often desirable, and sometimes even necessary to measure accurately the strength of the charge. This is effected by means of an instrument called the electrometer, the simplest form of which is represented by Fig. 2. and consists of an upright stem of box, furnished at the lower end with a brass ferule

and pin, by which it may be inserted in the conductor. To the upper part of the stem is affixed a graduated semicircle of ivory, about the middle of which is a brass arm, to support the axis of the index. The index is a very slender stick, which reaches from the centre of the plate to the ferule at the lower end of the stem; and to its extremity is fixed a delicate pith ball. This index rises as the charge proceeds, and when it is completed will stand at ninety, or at right angles with the stem.

The *universal discharger* is another instrument that will be found necessary in a great variety of experiments in which the battery is to be used.

Fig. 3. is a representation of Henley's universal discharger. A is a flat board, about fifteen inches long, four broad, and one thick. B B are two glass pillars, cemented in two holes upon the board A, and furnished at top with brass caps, each of which has a turning joint, and supports a spring tube, through which the wires D D slide. Each of the caps is composed of three pieces of brass, connected so that the wires D D, besides their sliding through the sockets, have a horizontal and vertical motion. Each of the wires D D is furnished with an open ring at one end, and at the other it has a brass ball, which, by a short spring socket, is slipped upon the pointed extremity, and may be removed. E is a circular piece of wood, having on its surface a slip of ivory inlaid, and furnished with a foot, which is fastened in the middle of the bottom A.

To this discharger belongs the small press, Fig. 4. the stem of which fits into the socket, instead of the circular table E. On the top of the stem are two oblong boards, which are pressed together by means of two screws. Between these boards may be placed any substance which requires to be pressed while the electric fluid is sent through it.

The construction of this instrument is such as to enable the operator to use it with advantage in numerous experiments, such as the oxidation of metallic leaves between slips of card or of glass; splitting small pieces of oak; firing gunpowder, &c.

By far the most interesting and brilliant application of the powers of the Leyden jar, is the melting of metallic wires. When a strong charge is passed through a slender iron wire, the wire is ignited or dispersed in red-hot globules. The power of large batteries was formerly considered essential to the production of this effect; but if the wire be sufficiently fine, a single jar, exposing a coated surface of about 190 square inches, will be found sufficient to exemplify the experiment. The finest flatted steel wire, sold at the watch-makers' tool shops, by the name of watch-pendulum wire, answers exceedingly well.

Cuthbertson's Balance Electrometer is an excellent and elegant regulator of the strength of the charge requisite for fusing different lengths of wire; and in public lectures is an indispensable article of apparatus. Fig. 5. represents this instrument, with the common quadrant electrometer inserted in the centre of the upper arm, which, it may be sufficient to mention, is accurately poised on a knife-edged centre. In using this electrometer, the arm A must be connected with the inside of the jar, and the insulated ball B with the outside. The wire to be fused must form part of the circuit. When the jar or battery is charged, C will be repelled by A, and D will thus descend to B, and discharge the jar or battery through the wire, which will be fused and run into balls. From numerous experiments it appears that the action of electricity on wires increases in the ratio of the square of the increased power; since *two* jars, charged to any degree, will melt four times the length of wire that is melted by *one jar*; and this will again be *quadrupled*, by *doubling* the height of the charge.

This law, Mr. Singer says he has found to obtain in all accurate experiments, with moderate lengths of wire: with a battery exposing forty feet of coated surface, he has frequently melted eighteen feet of iron wire, ($\frac{1}{250}$th of an inch diameter) by a single explosion, and the phenomena were remarkably brilliant, a shower of intensely ignited globules being dispersed in all directions.

Inflammable substances kindled by the electric fluid.

If a small quantity of spirit of wine be poured into a silver table spoon, and rendered a little warm by being held over a clear fire, it may be inflamed, by drawing from it a single spark, when the spoon is held by a person standing on the insulating stool, and holding in his other hand a chain, connected with the prime conductor. This experiment is sometimes varied, and rendered more striking in the following manner. Near the prime conductor of the machine, place on the table three wine glasses; connect the first glass with the conductor, by a brass chain, which will reach to the bottom of it, and with it, let the second and third be connected by a piece of fine brass wire, bent in the form of the letter A. Fill the first and second glasses with water, and into the third pour a little ether; turn the machine, and with a wire and ball, draw a spark from the ether and it will be immediately inflamed.

Gun-powder may be fired by the charge of a jar sent through it, if it be ground fine, and slightly rammed into a quill: there must be a brass wire inserted in each end of the quill; the wires should be thrust so far in, that their extremities may be within the fifth of an inch of each other. If the powder be mixed with clean steel filings, it will be the more readily fired.

If a small quantity of flax, or of cotton wool be *loosely* tied on one of the knobs of the discharging rod, and a little finely powdered resin dusted on it, and a jar be discharged by bringing the end of the rod thus prepared in contact with the knob of the jar, the charge will pass through the flax, or wool, and in so doing will melt and ignite the resin, and set the whole on fire. A very neat contrivance for giving this experiment a better effect is represented by Fig. 6. A is a mahogany board six inches in length, three in breadth, and half an inch in thickness. B is a glass pillar fixed in the middle of A, and supporting a piece of wood C, which is three inches long, an inch and a half broad, and about three quarters of an inch thick. In each end of this piece there is a small screw-ring: the extremities of these screws just touch a wire proceeding to each of them from two small brass knobs inserted at the ends of a shallow groove on the upper side of C; these rings serve to hook the chains or

when the instrument is used. On the back part of C stands the perpendicular piece D, in the top of which is fixed the brass pin E. To use this for the purpose of firing cotton wool it is only necessary to dust the cotton with powdered rosin, and hang it on the pin E, letting the lower part of it reach down to the piece C Connect one end of C with the inside of a jar and the other end with the outside; discharge the jar and the fluid in passing between the two small brass knobs will kindle the cotton. This neat little instrument is the invention of Dr. Roberts of Bridport.

Hydrogen gas may be readily inflamed by the electric spark. Fig. 7. is a representation of the electrical cannon chiefly used for this purpose. It is charged with the gas by holding the mouth of it closely over that of a stone or glass bottle in which the gas is generated; a few seconds will be sufficient; it must then be corked up, and the person who is to discharge it, standing on the insulating stool, must touch with his finger, or with a wire and ball, the knob A, and the spark will pass into the interior of the cannon through the glass tube B, and the gas will explode with a loud report, driving out the cork from the mouth of the cannon to a considerable distance.

Luminous exhibition of the electric fluid.

This effect is produced to the greatest advantage by forming different devices with spangles of tin foil on the surfaces of tubes, or plates of glass, and sending a succession of strong sparks along such devices; the spangles should be placed at a short distance from each other, and fixed on with strong gum water.

A mere inspection of the figures will convey an accurate idea of the nature of this kind of electrical apparatus: and it is only necessary to observe that the brilliancy of these exhibitions will depend on the darkness of the room in which they are made, the dryness of the apparatus, and the strength of the sparks. Fig. 8. is a representation of the simplest instrument used for this purpose; from the form of the direction in which the spangles are stuck on the glass, it is called the spiral tube. When used it is held in the hand by one end, while the other is brought sufficiently near the prime conductor to receive the spark.

Fig. 9. shews a combination of such tubes called the *illuminated dome*, the effect of which is extremely vivid when the experiment is well managed: Fig. 10. is a device for exhibiting the luminous appearance of the fluid through different colours painted on glass, the effect of this is also remarkably fine.

It is not necessary here to occupy the time of the reader with directions how to perform experiments of this description, since all that is required is to employ a machine of self-sufficient power to keep up a constant and vivid stream of the electrical matter, and to take care that there be a good conducting substance connected with the termination of the device to carry off the fluid to the earth.

The identity of lightning and the electric fluid.

Various proofs of this have been adduced by the best writers on electricity; but instead of enumerating them here it may be sufficient to observe that in as far as the limited powers of man have been able to carry experiment on the subject, nothing has yet occurred that can be mentioned as indicating the least difference, except in quantity, between the substance that flows so copiously from a good electrical machine, and that which flashes in the heavens producing some of the most awfully sublime phenomena in nature. But it is in the power of any person capable of using the common electrical apparatus to satisfy himself on this head by raising in the air a common paper kite having a pointed wire projecting a few inches from its highest part, and communicating with the string by which the kite is raised. In this string there should be a very fine thread of wire intertwined, such as is used by the manufacturers of metallic lace; or if this cannot be obtained the string may be simply wetted with water. If a kite thus prepared be raised in the air during a thunder storm, or at any other time when there is much electricity present, the fluid will descend copiously along the string, and may be collected in jars, and every kind of experiment performed with it as if it had been collected from a machine.

In making this experiment the string of the kite should be coiled round a rod of glass; and a chain should be suspended from it so as to touch the ground, as the electric matter sometimes flows down in such quantities as might prove dangerous to the operator were it not immediately conveyed to the earth.

The knowledge of the identity of lightning and the electric matter produced by the machine has been turned to great advantage in the production of those inventions by which not only valuable property, but, in many instances, human life also may be protected from the destructive effects of this powerful agent of nature. Valuable, however, as these inventions are, they are comparatively little attended to. Every building that stands in an exposed situation ought to be furnished with a conducting rod to save it from the effects of lightning; yet conductors on buildings are more curious than common in England; nay, what is still worse, church spires are but seldom provided with them, although they are generally surmounted by gilt ornaments peculiarly adapted to draw the lightning from the clouds. Ships that go within the tropical climates ought to be provided with the flexible conductors which are so easily adapted to the masts, and which prove a source of safety in the most violent thunder-storms, and yet it is said that masters of vessels sometimes carry these rods out with them, without being at the trouble of having them erected.

The utility of conductors is demonstrated by the common experiment called the thunder-house. This little article is variously constructed, but the most elegant form given to it, and that which shews the effect most strikingly is that represented by Fig. 11. The upper part of the pyramid consists of three distinct pieces, which are all thrown asunder by falling down when the moveable piece *a* is expelled by the charge passing along the conducting rod.

In treating of the luminous appearance of the electric fluid we should have noticed the singularly beautiful effect produced by passing it through a highly rarified medium.

The appearance of the fluid in this case strikingly resembles the *Aurora Borealis*; from which it has been thought that that phenomenon

is caused by the electricity of the atmosphere playing in the higher regions. This theory, however, is not well supported, and some recent facts seem to militate against it. To produce this exhibition a long glass tube, so mounted that it may be readily exhausted of the internal air, is essentially necessary. For this experiment and numerous others which we have not room to describe, we would warmly recommend the compound apparatus which is represented at Fig. 12. A is an insulating pillar of glass, which is screwed to the wooden foot B; and on this pillar all the apparatus may be screwed alternately. C D is an exhausted tube of glass, furnished at each end with brass caps; at the end D is a valve properly secured under the brass plate; a brass wire, with a ball, projects from the upper cap; a pointed wire proceeds from the bottom plate; and this tube is called the LUMINOUS CONDUCTOR. The flask represented at E is called the LEYDEN VACUUM. It is furnished with a valve under the ball E; to come at which the more readily, the ball may be unscrewed: a wire, with a blunt end, projects to within a little of the bottom of the flask, the latter being coated with tin foil: and a female screw is cemented to the bottom, to screw it on the pillar A.—F is a syringe to exhaust the air occasionally, either from the luminous conductor or the Leyden vacuum. To do this, unscrew the ball of the Leyden vacuum, or the plate of the luminous conductor, and then screw the syringe in the place of either of these pieces, being careful that the bottom of the female screw G bears close against the leather which covers the shoulders *a b* or *c d;* then work the syringe, and in a few minutes the glasses will be sufficiently exhausted. H and I are two Leyden bottles; each of which has a female screw fitted to the bottom, that they may be conveniently screwed on the pillar A; and the bottle H is furnished with a belt by which it may be screwed sidewise to the same. K and L are two small wires, to be screwed occasionally either into the ball E, the knobs *e* or *f*, the cap *c*, or the socket *g* on the top of the pillar; the balls may be unscrewed from these wires, which will then exhibit a blunt point. M is a wooden table to be screwed occasionally on the glass pillar.

Of the two Electricities.

There are two distinct kinds of electricity which were originally named by Du Fay, who made the discovery, the *vitreous* and the *resinous,* but are now denominated *positive* and *negative* electricity.

In whatever way electricity is produced, whether by friction, evaporation, heating or cooling, there is always the presence of the two distinct electricities. And it is now well known that *every* substance is an electric, or capable by friction of producing electrical phenomena. Thus for, instance, if we take any of those bodies formerly called non-electrics, and insulating it by a rod of glass or of any other convenient substance commonly termed an electric, and rub it with a piece of silk, or worsted, we shall find it become electrical. It will attract and repel light bodies, and yield sparks to the finger that approaches it: the distinction, therefore, formerly made between electrics, and non-electrics is groundless, and calculated to mislead.

On this principle we readily perceive how any body by friction may be made to exhibit either of the two electricities, according to the nature of the rubber. The only exception is the back of a cat, which gives the vitreous or positive electricity with every rubber hitherto tried.

The following is a table of several substances which acquire the vitreous electricity, when we rub them with those which follow them in the list; and the resinous electricity, when rubbed with those that precede them.

The skin of a cat.
Polished or smooth glass.
Woollen stuff or worsted.
Feathers.
Dry wood.
Paper.
Silk.
Lac.
Roughened glass.

The resulting fluids are necessarily co-existent, the one appearing on the body rubbed, and the other on the rubber; but since the one is most usually evolved on the surface-glass, and the other on that of resins, the first has been called the vitreous, and the second the resinous electricity. These two fluids, corresponding to the positive and negative of Franklin, by their reunion produce a species of reciprocal neutralization, and electrical repose.

This may be most satisfactorily shewn by the following simple experiment. Excite a glass tube by friction, and bring it gradually towards the gold-leaf electrometer Fig. 13. and the leaves will diverge with positive electricity. The same effect will be produced, but by negative electricity, by exciting a large stick of sealing wax. But let both the glass and the wax be excited at the same time, then, holding them in a perpendicular direction, parallel to, and at a little distance from each other, bring them near the electrometer, and not the slightest sign of electricity will be evinced by it.

To the scientific mind the exhibition of the two electricities must ever form a source of superior gratification in consequence of the indefinite variety of which the illustrative experiments admit; the ease with which most of them may be performed; and the extreme beauty and delicacy of many of them. But on this part of the subject we cannot enlarge; nor have we room to enter on the connexion of electricity with the medical science. Yet we must take this opportunity of stating, that, although there are many foolish, and even incredible things on record, as to the medical virtues of electricity, we have also sufficient proof that in the hands of a skilful operator, it may, in numerous cases, be applied with certainty of success.

Let no one however attempt to apply this agent in the healing art who is not thoroughly competent to judge of the real nature of the case, and to manage the application with prudence and skill.

The Electrophorus.

The electrophorus is certainly a very remarkable source of electrical accumulation, and is an instrument which, for many light experiments, forms a good substitute for the electrical machine. It is one of the ingenious contrivances of professor Volta, and is constructed

in the following manner. Procure two circular plates of metal, or of wood covered with tin foil, and well rounded at the edges; these are the conductors: between them is placed a resinous plate, formed by melting together equal parts of shell-lac, resin, and Venice turpentine, and pouring this mixture, whilst fluid, within a tin hoop of the required size, placed on a marble table, from which the plate may be readily separated when cold. This plate should be half an inch in thickness; it is sometimes made by pouring the mixture on one of the conductors, which is then formed with a rim for that purpose. In the centre of the upper conductor is fixed a glass handle of about ten inches long, for the purpose of lifting it without drawing off its electricity; and when the electric state of the lower conductor is to be examined, the whole apparatus must be placed on an insulating stand. To use the electrophorus, rub the upper surface of the resinous plate with a piece of dry fur, cat's skin is reckoned the best, and it will be excited negatively. Place the upper conductor upon it, and then raise the same by its insulating handle; it will be found to exhibit very faint, if any, electrical signs. Replace the conductor, and whilst it lies on the surface of the excited plate, touch it with a finger or any other uninsulated conductor, and then raise it again by its handle. It will now be positively electrified, and afford a spark: if it be then replaced on the resinous plate, touched, and again raised, another spark will be procured, and this process may be repeated for a considerable time without any perceptible diminution of effect. Jars may be charged by bringing them in contact with the conductor each time it is lifted, with an instrument of this kind only six inches in diameter. Cavallo charged a jar several times successively, and such was the strength of the charge that it was capable of piercing a card.

This instrument, properly constructed, has been known to retain its electricity so long as three weeks, without requiring fresh excitation.

Fig. 12. Plate XIII, represents the most common form of the electrophorus; it is sometimes fitted up with a contrivance for producing an instantaneous light by causing the spark to inflame hydrogen gas.

ELECTRO CHEMISTRY. See GALVANISM.

ELECTUARY, in pharmacy, a term in which both official and extemporaneous medicines are frequently made.

ELEGIA, a genus of the dioecia triandria class and order. There is one species, a native of the Cape, which has the habit of the rush.

ELEGIT, in law, is a writ of execution, either upon a judgment for debt or damages, or upon a forfeiture of the recognizance, taken in the King's court, by which the plaintiff is put in possession of one half the debtor's lands, which he is possessed of at the time to hold them till his debt is paid out of the profits.

ELEGY, a mournful and plaintive kind of poem. See POETRY.

ELEMENT, in physiology, a term used by philosophers to denote the original component parts of bodies, or those into which they are ultimately resolvable.

It seems to have been an opinion established among philosophers in the remotest ages, that there ar[illegible]ly four simple bodies, namely, fire, air, water, and earth. To these they gave the name of elements, because they believed that all substances are composed of these four. This opinion, variously modified indeed, was maintained by all the antient philosophers. We now know that all these supposed elements are compounds: fire is composed of caloric and light; air of caloric, oxygen and azotic gases; water of oxygen and hydrogen and the earth includes nine different substances.

ELENCHUS, in logic, a sophism, or fallacious argument, which deceives the hearer under the appearance of truth.

ELEPHAS, the ELEPHANT, a genus of the mammalia class, of the order bruta. The generic character is, cutting teeth none in either jaw; tusks in the upper jaw; proboscis very long, prehensile; body nearly naked.

The above is according to the classification of Linnæus, but by Cuvier the elephant placed among the pachydermera, or thick-skinned quadrupeds, in company with the sow, the river horse, and the rhinoceros; and under this genus are now ranked the following species.

1. *Elephas Africanus*, the African elephant. In this species the skull is rounded, processes of the enamel of the grinders forming a series of lozenges, touching each other in the middle; ears large; toes four before and three behind. The tusks of this species yield the best ivory, and are the largest in point of size. The hide is of a deep brown colour; and the ordinary height is from eight to upwards of ten feet. This animal inhabits the immense forests and the dreary wastes of Africa.

2. *Elephas Indicus*, Asiatic Elephant. The skull of this species is lengthened, the forehead concave, the enamel of the grinders disposed in the form of flattened ovals placed across the tooth; ears large, horny nails, five before and four behind. The general colour of this species is grey, speckled with brown, and sometimes white. The height is from eight to twelve feet.

This species inhabits the continent of Asia, and is found on both sides of the Ganges, in China, and in the larger islands of the Indian Ocean.

3. *Elephas Primigenius*. Fossil elephant, or mammoth. The skull is lengthened, forehead concave, under jaw, obtuse, grinders large, parallel processes of the enamel disposed in closely set ribbands, sockets of the tusks very long.

This species in all probability is now extinct, and it is only known from the numerous specimens of its bones which have been dug out of the earth: these are of immense size, and have been found in all the countries of Europe, from the Mediterranean sea to the arctic circle. In Asiatic Russia they occur in the greatest abundance.

They have also been found in the European isles, as Iceland, and various parts of Great Britain and Ireland; they have been dug up also in North and South America, and in Hudson's Bay.

The contrivances for taking elephants are various. The Ceylonese sometimes surround

the woods in bands, and drive, with lighted torches and all manner of noises, the elephants which inhabit them, till they are entrapped into a particular spot surrounded with pallisades. At other times a kind of decoy, or female elephant, is sent out in order to induce some of the males to pursue her, who are by this means secured. When a wild elephant is taken, it still remains to reduce it to a quiet state: and to tame it, in order to be made useful: this is effected by throwing ropes round the legs and body, which are well secured; and two tame elephants, properly instructed, are placed on each side. The captive animal finds himself gradually so fatigued by his ineffectual struggles, and so much soothed by the caresses occasionally given by the trunks of the tame elephants, by the food from time to time presented to him, and the water with which he is refreshed by pouring it over him, that in the space of some days he becomes completely tame, and is placed with the rest of the domesticated troop. Sometimes, in order to subdue them the more effectually, they are deprived of sleep for a considerable time.

The elephant brings only one young at a time; very rarely two: the young are about three feet high when they are first born, and continue growing till they are sixteen or twenty years old; they are said to live a hundred, or a hundred and twenty years.

In the Philosophical Transactions for the year 1799, we find some curious particulars relative to the natural history of the elephant, by Mr. Corse, whose residence in India afforded him opportunities of investigating the subject with exactness.

From these observations it appears that something must be subtracted from that elevated character with which this animal has been so frequently honoured; and that neither its docility nor its memory can be allowed a very high rank, when compared with those of some other animals; and that the scrupulous delicacy, which, as it was pretended, forbade all public demonstrations of its passions, is a mere fable. A female elephant has also been known to forget her young one, after having been separated from it for the short space of only two days, and to repel its advances. An elephant, also, which had escaped from its confinement, has again suffered itself to be trepanned, and reconducted to its state of captivity.

ELEPHANTIASIS, called also the lepra of the Arabians, in medicine, a chronical disease, one of the two species of leprosy, which affects the whole body, where even the bones as well as the skin are covered with spots and tumours, which being red, at last turn black.

ELEPHANTOPUS, *bastard-scabius*, in botany, a genus of the syngenesia polygamia segregata class of plants. There are four species, herbaceous plants of the East and West Indies.

ELEVATION, *angle of*, in gunnery, that comprehended between the horizon and the line of direction of a cannon or mortar; or it is that which the chase of a piece, or the axis of its hollow cylinder, makes with the plane of the horizon.

ELEVATION, in architecture, the same with an orthographic or upright draught of a building.

ELEVATION *of the host*, in the church of Rome, that part of the mass where the priest raises the host above his head for the people to adore.

ELEVATOR, the name of several muscles. See ANATOMY.

ELEVATORY, *elevatorium*, in surgery, an instrument for raising depressed or fractured parts of the scull, to be applied after the teguments and periosteum are removed.

ELISION, in grammar, the cutting off or suppressing a vowel at the end of a word, for the sake of sound or measure, the next word beginning with a vowel.

ELK. See CERVUS.

ELL, a measure of length, different in different countries; but those mostly used in England, are the English and Flemish ells, whereof the former is three feet nine inches, or one yard and a quarter, and the latter only twenty-seven inches, or three quarters of a yard. In Scotland, the ell contains $37\frac{2}{10}$ English inches.

ELLIPSIS, in geometry, a curve line returning into itself, and produced from the section of a cone by a plane cutting both its sides, but not parallel to the base. See CONIC SECTIONS, and MENSURATION.

ELLIPSIS, in grammar, a figure of syntax, wherein one or more words are not expressed; and from this deficiency it has got the name ellipsis.

ELLIPSIS, in rhetoric, a figure nearly allied to preterition, when the orator, through transport of passion, passes over many things: which, had he been cool, ought to have been mentioned.

ELLIPTOIDES, in geometry, a name used by some to denote infinite ellipses, defined by the equation $ay^{m+n} = bx^m (a-x)^n$.

Of these there are several sorts: thus, if $ay^3 = bx^2 (a-x)$ it is a cubical elliptoid; and if $ay^4 = bx^2 (a-x)^2$, it denotes a biquadratic elliptoid, which is an ellipsis of the third order in respect of the appollonian ellipsis.

ELLISIA, a genus of the monogynia order, in the pentandria class of plants; and in the natural method ranking under the 23d order, luridæ. There is one species, an annual plant of Virginia.

ELOCUTION, in rhetoric, the adapting words and sentences to the things or sentiments to be expressed. It consists of elegance, composition, and dignity. The first, comprehending the purity and perspicuity of a language, is the foundation of elocution. The second ranges the words in proper order; and the last adds the ornaments of tropes and figures to give strength and dignity to the whole.

ELONGATION, in astronomy, the digression or recess of a planet from the sun, with respect to an eye placed on our earth. The term is chiefly used in speaking of Venus and Mercury, the arch of a great circle intercepted between either of these planets and the sun, being called the elongation of that planet from the sun.

ELONGATION is also used for the difference in motion between the swiftest and the slowest of two planets, or the quantity of space the one has passed beyond the other

ELOPS, a genus of fishes of the order of abdominales, of which there is but a single species, viz. the saurus, or scar-fish, which inhabits the coast of Carolina.

ELYMUS, a genus of the digynia order, in the triandria class of plants; and in the natural method ranking under the fourth order, *gramina*. There are 11 species, known in general by the name of lyme grass; they may be found in most parts of the world.

EMBALMING, is the opening of a dead body, taking out the intestines, and filling the place with odoriferous and desiccative drugs and spices, to prevent its putrifying. The Egyptians excelled all other nations in the art of preserving bodies from corruption; for some that they have embalmed upwards of 2000 years ago, remain whole to this day, and are often brought into other countries as great curiosities.

EMBARGO, in commerce, an arrest on ships, or merchandize, by public authority; or a prohibition of the state, commonly on foreign ships, in time of war, to prevent their going out of port, sometimes to prevent their coming in, and sometimes both, for a limited time.

EMBERIZA, in ornithology, a genus of birds belonging to the order of passeres. There are 24 species, of which the most remarkable are,

1. The nivalis, or great pyed mountain finch of Ray, and the snow-bird of Edwards; it has white wings, but the outer edges of the primo feathers are black; the tail is black, with three white feathers on each side. These birds are called in Scotland snow flakes, from their appearance in hard weather and deep snows. They arrive in that season among the Cheviot-hills and in the Highlands in amazing flocks.

2. The miliaris, or grey emberiza, is of a greyish colour, spotted with black in the belly, and the orbits are reddish. It is the bunting of English authors, and a bird of Europe.

3. The hortulana, or ortolan, has black wings; the first three feathers on the tail are white on the edges, only the two lateral are black outwardly. The orbits of the eyes are naked and yellow; the head is greenish, and yellow towards the inferior mandible. It feeds principally upon the millet, grows very fat, and is reckoned a delicate morsel by certain epicures, especially when fattened artificially. These birds are found in several parts of Europe, but are not met with in Britain.

4. The citrinella, or yellow-hammer, has a blackish tail, only the two outward side-feathers are marked on the inner edge with sharp white spots. It is a bird of Europe, and comes about houses in winter.

5 The schœniclus, or reed-sparrow, has a black head, a blackish-grey body, and a white spot on the quill-feathers. It inhabits marshy places, most commonly among reeds, from which it takes its name. Its nest is worthy of notice for the artful contrivance of it, being fastened to four reeds, and suspended by them like a hammock, about three feet above the water.

6. The oryzivora, or rice-bunting, with the head and whole under-side of the body black; hind part of the neck in some pale yellow, and in others white; coverts of the wings and primaries, black, the last edged with white; part of the scapulars, lesser coverts of the wings, and rump, white; back black, edged with dull yellow; tail of the same colours, and each feather sharply pointed; the legs are red.

7. The cirlus is brown; breast spotted; eyebrows pale yellow; the two outmost tail-feathers with a white wedged spot. It inhabits France and Italy, and feeds on seeds, worms, and insects.

8. The ciris; the head blue; belly orange; back green; the feathers green brown. Inhabits South America.

EMBLEM, a kind of painted enigma, or certain figures painted or cut metaphorically, expressing some action, with reflections underneath, which, in some measure, explain the sense of the device, and at the same time instruct us in some moral truth, or other matter of knowledge. The emblem is somewhat plainer than the enigma, and the invention is more modern, it being entirely unknown to the ancients.

EMBOSSING, or *imbossing*, in architecture and sculpture, the forming or fashioning works in relievo, whether cut with a chissel or otherwise.

EMBOTHRUN, a genus of the class and order tetrandria monogynia. There are four species, handsome shrubs of New Holland and South America.

EMBRASURE. See ARCHITECTURE.

EMBRASURE, in fortification, a hole or aperture in a parapet through which the cannon are pointed to fire into the moat or field.

EMBROCATION, in surgery and pharmacy, an external kind of remedy, which consists in an irrigation of the part affected, with some proper liquor, as oils, spirits, &c.

EMBROIDERY, a work in gold or silver, or silk thread, wrought by the needle upon cloth, stuffs, or muslin, into various figures. In embroidering stuffs, the work is performed in a kind of loom, because the more the piece is stretched, the easier it is worked. As to muslin, they spread it upon a pattern ready designed; and sometimes, before it is stretched upon the pattern, it is starched, to make it more easy to handle.

EMERALD, in natural history, a precious stone, of a green colour, and next in hardness to the ruby.

Its texture is foliated. Its fracture conchoidal. Causes a double refraction. Hardness 12. Specific gravity 2.9. to 3.3. Colour green. Becomes electric by friction, but not by heat. Its power does not phosphoresce when thrown on a hot iron. At 150° Wedgewood it melts into an opaque coloured mass. According to Dolomieu, it is fusible per se by the blowpipe.

This mineral was formerly subdivided into two species; the emerald, and beryl or aqua marina. Hauy demonstrated, that the emerald and beryl correspond exactly in their structure and properties; and Vauquelin found that they were composed of the same ingredients; henceforth, therefore, they must be considered as varieties of the same species.

EMERSION, in astronomy, is when any planet that is eclipsed begins to emerge or get out of the shadow of the eclipsing body. It is also used when a star, before hidden by the sun as being too near him, begins to re-appear or emerge out of his rays.

EMERY. A sub-species of rhomboidal

corundum. Its colour is intermediate between greyish-black and bluish-grey. It occurs massive and disseminated, and also in granular concretions. Lustre, glistening and adamantine. Fracture, fine grained uneven. Translucent on the edges. So very hard as to scratch topaz. Difficultly frangible. Sp. gr. 4.0. Its constituents are 86 alumina, 3 silica, 4 iron, and 7 loss. In Saxony, it occurs in beds of talc and steatite. It occurs abundantly in the Isle of Naxos, and also at Smyrna. It is used for polishing hard minerals and metals. Its fine powder is obtained by trituration and elutriation.

EMOLLIENTS, in medicine and pharmacy, are such remedies as sheath and soften the asperity of the humours, and relax and supple the solids at the same time.

EMPETRUM, *berry-bearing heath*, a genus of the triandria order, in the monœcia class of plants. In the natural method this genus is ranked by Linnæus under the 54th order miscellaneæ; and likewise among those of which the order is doubtful. There are two species; one of which, viz. the nigrum, bears the crow-cake berries, and is a native of Britain. It grows wild on boggy heaths and mountains. Children sometimes eat the berries.

EMPIS, in zoology, a genus of insects belonging to the order diptera, of which the characters are these: the proboscis is of a horny substance, bivalve, reflected under the head and breast, and longer than the thorax. There are five species.

EMPLEURUM, a genus of the monœcia tetrandria class and order. The male calyx is four-cleft; corolla none; fem. calyx, four-cleft inferior; corolla none; stigma cylindric; caps. opening at the side; seed one, arilled. There is one species, a shrub of the Cape.

EMPYREUMA. This term is applied to denote the peculiar smell produced by a considerable heat upon vegetable or animal substances in closed vessels, or when burned under circumstances which prevent the access of air to a considerable part of the mass, and consequently occasion an imperfect combustion, or destructive distillation of the parts so covered up by the rest of the mass.

EMULSION. An imperfect combination of oil and water, by the intervention of some other substance capable of combining with both these substances. The substances are either saccharine or mucilaginous.

ENAMEL. There are two kinds of enamel, the opaque and the transparent. Transparent enamels are usually rendered opaque by adding putty, or the white oxide of tin, to them. The basis of all enamels is therefore a perfectly transparent and fusible glass. The oxide of tin renders this of a beautiful white, the perfection of which is greater when a small quantity of manganese is likewise added. If the oxide of tin be not sufficient to destroy the transparency of the mixture, it produces a semi-opaque glass, resembling the opal.

Yellow enamel is formed by the addition of oxide of lead or antimony. Kunckel likewise affirms, that a beautiful yellow may be obtained from silver.

Red enamel is afforded by the oxide of gold, and also by that of iron. The former is the most beautiful, and stands the fire very well, which the latter does not.

Oxide of copper affords a green; manganese, a violet; cobalt, a blue; and iron, a very fine black. A mixture of these different enamels produces a great variety of intermediate colours, according to their nature and proportion. In this branch of the art, the coloured enamels are sometimes mixed with each other, and sometimes the oxides are mixed before they are added to the vitreous bases.

In the Transactions of the Society of Arts for 1817, a valuable list of receipts for enamel colours is given by Mr. R. Wynn, for the communication of which a premium was awarded. The following are Mr. Wynn's fluxes:—

No. 1.	Red lead,	8 parts.
	Calcined borax,	1½
	Flint powder,	2
	Flint glass,	6
No. 2.	Flint glass,	10
	White arsenic,	1
	Nitre,	1
No. 3.	Red lead,	1
	Flint glass,	3
No. 4.	Red lead,	9½
	Borax not calcined,	5½
	Flint glass	8
No. 5.	Flint glass,	6
	Flux, No. 2.	4
	Red lead,	8

After the fluxes have been melted, they should be poured on a flag stone, wet with a sponge; or into a large pan of clean water, then dried, and finely pounded in a biscuit-ware mortar for use.

Yellow enamel.

Red led,	8
Oxide of antimony,	1
White oxide of tin.	1

Mix the ingredients well in a biscuit-ware mortar, and having put them on a piece of Dutch tile in the muffle, make it gradually red-hot, and suffer it to cool. Take of this mixture 1, of flux No. 4. 1½; grind them in water for use. By varying the proportions of red lead and antimony, different shades of colour may be obtained.

Orange.

Red lead,	12
Red sulphate of iron,	1
Oxide of antimony,	4
Flint powder,	3

After calcining these without melting, fuse 1 part of the compound with 2½ of flux.

Dark red.

Sulphate of iron calcined dark,	1	
Flux, No. 4.	6 parts	of this 3
Colcothar,	1	

Light Red.

Red sulphate of iron,	1
Flux, No. 1.	3
White lead,	1½

Brown.

Manganese,	2
Red lead,	8
Flint powder,	4

ENARGEA, a genus of the hexandria monogynia class and order. There is no calyx: the petals are six; berry three-celled; four or

five globular seeds. There is one species, a native of Terra del Fuego.

ENCAUSTIC, and **ENCAUSTUM**, the same with enamelling and enamel. See ENAMELLING, and ENAMEL.

ENCAUSTIC *painting*, a method of painting made use of by the ancients, in which wax was employed to give a gloss to their colours, and to preserve them from the injuries of the air See PAINTING.

ENCHASING, or *chasing*, the art of enriching and beautifying gold, silver, and other metal work, by some design, or figures represented thereon, in low relievo. See RELIEVO and SCULPTURE.

ENCHASING is practised only on hollow thin works, as watch-cases, cane-heads, or the like. It is performed by punching or driving out the metal, to form the figure, from withinside, so as to stand out prominent from the plane or surface of the metal. In order to this they provide a number of fine steel blocks, or puncheons, of divers sizes; and the design being drawn on the surface of the metal, they apply the inside upon the heads or tops of these blocks, directly under the lines or parts of the figures; then with a fine hammer, striking on the metal, sustained by the block, the metal yields and the block makes an indenture or cavity on the inside, corresponding to which there is a prominence on the outside, which is to stand for that part of the figure.

Thus the workman proceeds to chase and finish all the parts by successive applications of the block and hammer, to the several parts of the design.

ENCHELIS, in natural history, a genus of the Vermes Infusoria. Worm invisible to the naked eye, very simple, cylindrical. There are fifteen species. An account of these may be found in Adams, "On the Microscope."

ENCROACHMENT, in law, an unlawful gaining upon the rights or possessions of another. It is generally applied to the unlawful occupation of wastes and commons.

ENDEMIC, or *endemical-diseases*, those to which the inhabitants of particular countries are subject more than others, on account of the air, water, situation, and manner of living.

ENDIVE, in botany, &c. broad-leaved succory.

ENDOWMENT, in law, is the widow's portion, being a third part of all the freehold lands and tenements, of which her husband was seized at any time during the coverture.

ENEMY, in law, an alien or foreigner, who in a public capacity invades any country, and who cannot be punished as a traitor, but must be subjected to martial law.

ENFRANCHISEMENT, in law, the incorporating a person into any society or body politic; such as the enfranchisemen of one made a citizen of London or other city, or burgess of any town corporate, because he is made partaker of its liberties, or franchises.

ENGINE, in mechanics, is a compound machine, consisting of one or more mechanical powers, as levers, pulleys, screws, &c. in order to raise, cast, or sustain any weight, or produce any effect which could not be easily effected otherwise. See MECHANICS.

Engines are extremely numerous; some used in war, as the battering-ram, balista, waggons, chariots, &c.; others in trade and manufactures, as cranes, mills, presses, &c.; See MECHANICS, HYDROSTATICS, STEAM-ENGINE, &c.

ENGINEER, a term applied to designate a part of the artillery. Their office is to contrive attacks at sieges, and to defend towns when besieged. Engineers have the entire construction and disposition of all forts, redoubts, batteries, mines, &c.: the fortifying of camps and posts; reconnoitering the enemy's works; taking plans and surveys of a country; discovering the most advantageous methods for marching, retreating, attacking, or defending: building of all fortifications, magazines, and other military erections; they must therefore be men of science, and particularly skilled in mathematics and military architecture.

ENGRAILED, or *ingrailed*, in heraldry, a term derived from the French *grele*, hail; and signifying a thing the hail has fallen upon and broke off the edges, leaving them ragged, or with half-rounds or semicircles struck out of their edges.

ENGRAVING. The term engraving, as used at present, signifies the art of cutting wood, copper, steel, or other substances in lines, so managed as to produce imitations of drawings, paintings, &c. when printed on paper.

This art is said to have been discovered by a goldsmith of Florence named Maso Finigerra, but this can only apply to his having obtained impressions from lines engraved originally without any idea of such a result. The art itself must be of the greatest antiquity, since we find it was used among the Jews in the decorations of the Tabernacle. Bezaleel and Aholiab are mentioned in the Book of Exodus as "*filled with wisdom of art, to work all manner of work with the graver,*" &c.; and it is highly probable that the Israelites obtained this art from the Egyptians.

Of engravings there are different kinds; but that which is performed by the graver is the oldest, and to it in common language, the term *engraving* is often exclusively applied, in contradistinction etching, mezzotinto, or any other method.

The principal instruments used in stroke engraving are, the graver or burin, of which there are various sorts; a scraper, a burnisher, and a cushion for supporting the plate.

The graver is an instrument made of steel, of the form of a quadrangular prism, about one tenth of an inch thick, increasing a little in thickness as it approaches the handle which is made of wood, and nearly of a pear shape with a longitudinal slice cut off, for the purpose of enabling the artist to use it as flat on the plate as his fingers and thumb will permit.

The burnisher is about three inches long its use is to soften any of the lines that may be cut too deep.

The scraper is made of steel also: it is generally about six inches long, tapering to a point, and having three sharp edges. It is used for scraping off the barb that is formed by the action of the graver, and for erasing erroneous lines. To shew the appearance of the work as it proceeds, and to polish off the barb more completely, a roll of felt or woollen

cloth, called a rubber, is used for rubbing the part of the plate with a little oil olive.

The cushion is a leather bag filled with sand, in general about nine inches diameter; it was formerly used for laying the plate upon, to allow it to be readily turned in any direction; but it is now very little used, except by the engravers of writing.

For engraving a series of parallel lines, straight or curved, equidistant, or gradually approximating to each other, such as in the blue parts of a sky, water, machinery, &c. where a smooth tint is required, an apparatus was some years ago invented by the late, and truly ingenious Mr. Wilson Lowery, of London.

It is called the ruling machine; its action is mathematically perfect, and the beauty of the execution is altogther unequalled.

For the purpose of conveying a comprehensive idea of the different branches of this admirable art to the reader, we shall here treat of them separately.

1. *Stroke engraving*, or engraving on copper, in the most limited use of the term. Here the first thing to be done, after the plate is well prepared, is to trace the design intended for engraving accurately on the plate, it is usual to heat the latter sufficiently to melt white wax, with which it must be covered equally, and suffered to cool; the drawing is then copied in outlines with a black-lead pencil on paper, which is laid with the pencilled side upon the wax, and the back rubbed gently with the burnisher, which will transfer the lead to the wax. The design must next be traced with an etching needle through the wax on the copper, when, on wiping it clean, it will exhibit all the outlines ready for the graver.

The table intended for engraving on should be perfectly steady, and the sandbags placed equally firm; in cutting of curved or undulating lines, the graver must be held still, or moved, to suit the turning of the plate with the left hand but when straight lines are intended, the plate is to be held stationary, and the graver urged forward with more or less pressure, according to the thickness of the line. Great care is necessary to carry the hand with such steadiness and skill as to prevent the end of the line from being stronger and deeper than the commencement; and sufficient space must be left between the lines to enable the artist to make those stronger, gradually, which require it.

If any accident should occur by the slipping of the graver beyond the boundary required, or lines are found to be placed erroneously, they are to be effaced by the burnisher, which leaving deep indentings, those must be levelled by the scraper, rubbed with charcoal and water, and finally polished lightly with the burnisher.

As the uninterrupted light of the day causes a glare upon the surface of the copper, hurtful and dazzling to the eyes, it is customary to engrave beneath the shade of silk paper, stretched on a square frame, which is placed reclining towards the room near the sill of a window.

Such are the directions and means to be employed in engraving historical subjects: indeed the graver is equally necessary for the completion of imperfections in etching, to which must be added the use of the dry point in both, for making the faintest shades in the sky, architecture, drapery, water, &c. &c.

2. *Mezzotinto Engraving*, commonly called mezzotinto scraping, differs entirely from the manner above described; this method of producing prints, which resemble drawings in Indian ink, was some years past a very favourite way of engraving portraits and historical subjects; of the former, the large heads by Fry are of superior excellence.

The tools required for this mode of proceeding, are the grounding-tool, the scraper, and the burnisher; the copper-plate should be prepared as if intended for the graver, and laid flat upon a table, with a piece of flannel spread under it to prevent the plate from slipping; the grounding-tool is then held perpendicularly on it, and rocked with moderate pressure backwards and forwards, till the teeth of the tool have equally and regularly marked the copper from side to side; the operation is afterwards repeated from end to end, and from each corner to the opposite; but the tool must never be permitted to cut twice in the same place; by this means the surface is converted into a rough chaos of intersections, which, if covered with ink and printed, would present a perfectly black impression upon the paper.

To transfer the design to be scraped, it is usual to rub the rough side of the plate with a rag dipped into the scrapings of black chalk, or to smoke it with burning wax taper, as in the process for etching; the back of the design is then covered with a mixture of powdered red chalk and flake white, and laid on the plate through which it is traced; particles of red, in the form of the outlines, are thus conveyed to the black chalk on the plate, which are to be secured there by the marks of a blunted point; the process must then be carried on with the scraper, by restoring the plate in the perfectly light parts of the intended print to a smooth surface, from which the gradations are preserved by scraping off more or less of the rough ground; but the burnisher is necessary to polish the extreme edges of drapery, &c., where the free touch of the brush in painting represents a brilliant spot of light. The deepest shades are sometimes etched and corroded by aqua fortis, and so blended with the mezzotinto ground added afterwards, that there is nothing offensive to the eye in the combination.

Many proofs are required to ascertain whether the scraping approaches the desired effect, which is done by touching the deficient parts with white or black chalk, on one of the proofs from the original drawing, and then endeavouring to make the plate similar by further scraping, or re-laying the ground with a small tool made for this particular purpose, where too much of the roughness has been effaced.

3. **Etching.** This is an expeditious method of engraving, and when well executed, has a remarkably bold and pleasing effect. The process is this. The plate being prepared as for engraving, is completely covered over with a ground capable of resisting the action of aqua fortis. The design is made with a black-lead pencil on a piece of paper of the same size, which, being moistened in water, and laid on the plate with its face next the etching

ground, and run through the rolling press, leaves a distinct impression on it, which is partially transferred from the paper. The process of using the needle now takes place, in which nothing more is required than to keep it upright, that the lines made by it through the ground may not slope, which would cause the acid to corrode in an improper direction. Great care is necessary to keep the point in such a state of fineness as to prevent its tearing the copper, which would ruin the design.

When the etching of the plate is completely finished, the edges of it must be surrounded by a high border of wax, so well secured that water will not penetrate between the plate and it. The best spirits of nitre fortis must then be diluted with water, in the proportion of one part of the former to four of the latter, which will be found to answer the first operations, if the weather is fine and the atmosphere free from moisture; but, if the contrary is the case, the spirits of nitre must be increased in proportion to the humidity of the air; this, when poured on the plate, cannot be too attentively observed in order to remove the bubbles of fixed air with a feather, and to ascertain the time for stopping out the lightest parts; for it must be remembered the whole secret of biting or corroding any subject consists in the judicious manner in which the depth and breadth of the lines are varied, as by proper management they may be left scarcely perceptible, or increased very considerably. The composition used for the above purpose is, turpentine varnish mixed with lamb-black, and diluted so as to be used freely with a camel's hair pencil; this applied to the parts of the plate sufficiently corroded, will effectually prevent the aqua fortis from touching it again, and the remainder proceeds as if no such application had taken place: it will be necessary to strengthen the water as the work becomes nearer completion, but cautiously, lest the ground should be broken; and every time the aqua fortis is removed the plate must be washed with clean water and gradually dried, otherwise the varnish cannot be used, and the lines would be clogged with the decomposed metal. For taking the ground from the plate it is usual to cover the surface with olive oil, and heating it. wipe the plate with a soft piece of old linen and spirits of turpentine, will effectually remove all remaining dirt.

Etching with what is termed the *dry point* is effected without laying any ground on the plate, simply by the point of the needle; and the barb which is raised by the operation is taken off by the scraper.

4. *Aquatinta Engraving*, or what is by some called the *soft ground*, is a method of making imitations of black-lead or chalk drawings This species of engraving is soft and pleasing, and is well adapted for all picturesque scenery. It is also recommended for the ease with which it is performed.

The principal upon which aquatinta engraving is performed may be thus described. The copper-plate being prepared in the usual manner, is sprinkled over with a resinous powder; the plate being warm the resin adheres in a granulated form to the plate. The nitric acid is then poured on, and immediately attacks the copper, corroding it in all the innumerable interstices where it was left uncovered by the resin, so that if an impression were taken from the plate, the effect would resemble a wash of Indian ink. The different shades are produced by allowing the acid to act for a longer or a shorter space of time on the copper.

In the common aquatinta process, the plate is covered with the common etching ground, and the outlines of the design are etched in the usual manner. The ground is then removed, and the plate is slightly rubbed with the oil-rubber. It is then dusted over with gum copal reduced to a fine powder; the copal must be tied up in a muslin bag, and caused to fall from some height above the plate, by striking the hand in which it is held against a ruler or some other substance held in the other hand, till the shower of dust thus produced has covered the surface of the plate equally throughout. Preserving it carefully in this situation the plate must be warmed sufficiently to melt the powder, which will cause the grains to assume a globular form, and contract, leaving, when cold, a beautiful surface fit for the action of the acid. Common resin is generally preferred for this part of the operation; but gum-copal is less liable to be broken loose from the plate during the process of biting.

The drawing to be copied must serve as the future basis of proceeding, which is to be imitated in the following manner: the perfectly white parts of the intended print are to be covered on the plate, with the varnish mentioned in etching, by the use of a camel's-hair pencil; a border of wax must then be raised, and the aqua fortis diluted poured on; the same method is afterwards practised in the stopping out before recommended, except that the depth of the corroding cannot be so great as in the line manner.

In order to obviate any difficulties which occur in procuring sufficient depths of shade, a method has been invented that enables the artist to produce an effect almost equal to the decisive touches of a brush filled with colour in drawing, which is the use of a liquid made with water, treacle, or sugar, and fine washed whiting, exactly of the consistence of Indian ink, and laid on the granulated surface with a pencil, in the same free manner adopted on paper; after the above composition is thoroughly dry, the whole plate must be covered with a thin, weak, varnish of mastich, turpentine, or asphaltum, and when dried a second time, the aqua fortis is to be applied, which immediately breaking the varnish and whiting, will corrode the plate precisely in the marks of the pencil. The border of wax may be removed by heating the plate gently, and the ground varnish, &c. by oil of turpentine; a little fine whiting and a clean rag will then render the plate fit for the printer.

Such is the common method of engraving in aquatinta; but there are other methods adopted by modern artists, which are much superior, but which they have not yet thought proper to make public.

5. *Stippling*, or the chalk manner is also performed upon the etching ground, by dots instead of lines made with the etching needle This beautiful effect is produced by a wheel, consisting of many points diverging from its centre, and revolving on its centre This instrument is moved forwards and backwards

on the plate, its motions being regulated by the skill of the artist, until it has sufficiently marked the copper, producing an excellent imitation of chalk-drawing; the work is then bitten with acid in the usual way. Ryland and Bartalozzi were the most distinguished in this art

6. *Engraving on Wood.* Engraving on wood is a process exactly the reverse to engraving on copper. In the latter, the strokes to be printed are sunk, or cut into the co and a rolling-press is used for printing it; but in engraving on wood, all the wood is cut away, except the lines to be printed, which are left standing up like types, and the mode of printing is the same as that used in letter-press.

The wood used for this purpose is box wood, which is planed quite smooth. The design is then drawn upon the wood itself with black lead; and all the wood is cut away with gravers and other proper tools, except the lines that are drawn: or sometimes the design is drawn upon paper, and pasted upon the wood, which is cut as before. The art is of considerable difficulty, and there are very few who practise it. It is, however, useful for books, as the printing of it is cheaper than that of copper-plates. It cannot be applied equally well to all the purposes to which copper-plate engraving is applicable.

7. *Engraving on stone,* is a method of imitating pen and ink drawings, for which the inventor some years ago obtained a patent. It is performed on a slab of close-grained stone.

The design is made out with a pen, dipped in a solution of lac, in the ley of pure soda, with a little soap, and coloured with lamp black. When the drawing has been on the stone for three or four days, or when the ink is perfectly dry, it is soaked in water. While wet, it is daubed with printers' ink, and the ink adheres to the design and not to the stone. The impression is then taken from it in the same way as letter-press printing, by putting a sheet of damp paper over it, and subjecting it to the action of the press.

This method of engraving is called *lithography*, and, although only a modern invention, it has already been carried to great perfection.

Another method is, to take calcareous stone or slab of marble, with a good polish, of about two or three inches in thickness, and of a size proportioned to that of the design to be executed on it. The design, whatever it may be, is marked out with a solution of gum lac and pot-ash, coloured with lamp black. When it is dry, the stone is covered with aqua-fortis, which, attacking all parts of the stone except those impregnated with the resinous acid, the drawing remains untouched, and [illegible]ears like the block of a woodcut.

After the acid has bitten sufficiently deep, the slab must be washed with clean water, and while wet, printing ink is applied to it in the usual way, and it is put through the press.

After each impression the block must be washed with water. This method, for expedition, cheapness, and durability, has decidedly the advantage over the usual process, particularly for music; it is said that at the Stone Printing Office at Vienna, thirty thousand im- were taken off the same slab, the last impression being nearly as good as the first.

8. *Engraving on steel.* This is principally employed for cutting signets, matrices, punches, and dies for striking coins and medals. The engraving of the device on the punches is performed in relievo, after a wax model; and when finished, it is tempered so as to stand the strokes of the hammer in striking in the impression on the matrix. The steel of the die is made soft by heat, that it may take the impression of the punch; and when struck, is touched up by graving tools, chisels, &c. where there are any deficiencies.

Etching on steel is effected by drawing the design with Brunswick black, laid on with a hair pencil. It is then bedded in glaziers' putty, or the bordering wax used for etching, and the aqua-fortis poured over it, and suffered to remain till it be bitten to the requisite depth. It is then poured off, and the black cleaned away with a little turpentine.

9. *Etching on glass.* This is done by laying on a ground consisting of a thin coat of bees wax, and making out the design with an etching needle. The glass plate is then placed in a leaden vessel and exposed to the action of the fumes of fluoric acid. In the course of a few hours it may be removed, and the parts of the glass that were laid bare will be found to be corroded. The plate being cleaned with some oil of turpentine, impressions may be taken from it in the usual way. This method is used for ornamenting vessels of glass instead of grinding.

10. *Seal Engraving.* The art of seal engraving appears to be of great antiquity; it is performed both in cameo and intaglio, and extends to all kinds of precious stones. The operation is performed by inserting the tools into the axis of a small iron-wheel, which is attached to an apparatus resembling a turning lathe, and kept in motion by the foot. The tools are tightened by a screw, and the stone to be engraved is held by the hand to the tool as it revolves, and is conducted as the nature of the figure requires.

The tools are generally made of iron, and are of various forms, as chisels, gouges, &c.

ENMANCHE, in heraldry, is when lines are drawn from the centre of the upper edge of the chief to the sides, to about half the breadth of the chief; signifying sleeved, or resembling a sleeve.

ENNEANDRIA, in botany, the ninth class of plants with hermaphrodite flowers, and nine stamina or male parts in each. See BOTANY. To this class belong the laurus, rheum, spondias, butomus, &c.

ENSIFORM, in general, something resembling a sword, ensis: thus we find mention of ensiform leaves, ensiform cartilage, &c.

ENSIGN, in the military art, a banner under which the soldiers are ranged according to the different companies or parties they belong to.

ENSIGN is also the officer that carries the colours, being the lowest commissioned officer in a company of foot, subordinate to the captain and lieutenant.

ENTABLATURE, or *entablement*, in architecture, is that part of an order of a co

lumn which is over the capital, and comprehends the architrave, frieze, and cornice.

Entablature, in masonry, is used sometimes to denote the last row of stones on the top of the wall of a building, on which the timber and covering rest.

ENTAIL, in law, is a fee-estate entailed; that is, abridged and limited to certain conditions prescribed by the donor or grantor.

ENTOMOLOGY from *εντομα an insect* and λογος *a discourse*, is the science which treats of insects. As animals of this class constitute the most considerable portion of animated beings, entomology becomes one of the most interesting and important sciences which can engage the mind of the philosopher; and one which affords the most ample scope for his zeal. From the narrowness of our limits we can here offer only a few general remarks on the subject and put the reader in possession of the classification of insects as given by Linnæus.

Insects are distinguished from other animals by their being furnished with several feet; never fewer than six, and sometimes with many more; by their breathing, not through lungs, but by spiracles or breathing-holes, situated at certain distances along each side of the body; and lastly, by the head being furnished with a pair of *antennæ*, or jointed horns, which are extremely various in the different tribes. The first state in which the generality of insects appear, is that of an *egg*. From this is hatched the animal in its second state, in which it is often but improperly called the *caterpillar*. The insect, in this state, is the *larva* or larve, being a mask or disguise of the animal in its future form. The larve differs in its appearance, according to the tribe to which it belongs. When the time arrives for the larve to change into its next state of *chrysalis*, or *pupa*, it ceases to feed, and having placed itself in some quiet situation, for the purpose, lies still for several hours; and then, by a kind of laborious effort, frequently repeated, divests itself of its external skin, or larve-coat, and immediately appears in the very different form of a pupa. The pupa emerges at length the complete insect, in its perfect or ultimate form, from which it never can after change, nor can it receive any further increase of growth. This last or perfect state is termed the *imago*.

Some insects undergo a change of shape, but are hatched from the egg complete, in all their parts, and only cast their skin from time to time, during their growth, till they acquire the full size of their respective species. The *mouth*, in some tribes, is formed for gnawing or breaking the food, and operates by a pair of strong horny jaws, moving laterally, as in the beetle tribe; while in others, it is formed for suction, and consists of a sort of tube. In the butterfly, and moth tribe, it consists of a double tube, which, when at rest, is rolled into a spiral form, and extended at full length when in use. The *eyes* differ in the different tribes, but by far the greater part of insects are furnished with eyes apparently two in number, and situated on each side the head. The outward surface of the coats of these eyes may be compared to so many convex lenses or glasses. The head of the *libellula*, or common dragon-fly, is furnished with 25,000 of these diminutive lenses! In *spiders*, the eyes are from six to eight in number; of a simple structure, and placed at a considerable distance from each other.

3. The *muscles*, or organs, constituting the several portions of the flesh in insects, are far more numerous than in the larger animals, and are extremely sensible or irritable. In the human body, the muscles scarcely exceed 500, but in a large caterpillar more than 4000 have been discovered! The power of the muscles is also much greater than in animals. A flea is capable of springing at least 200 times its own length; whereas the jerboa and kangaroo in their most powerful springs, fall very short of the same *proportional* distance. Insects are divided into seven orders: *coleoptera, hemiptera, lepidoptera, neuroptera, hymenoptera, diptera*, and *aptera*.

Order 1. *Coleoptera*, or insects which have a hollow horny case, under which the wings are folded, when not in use. The genera are: 1. *Scarabæus*, beetles. 2. *Lucanus*, stag-beetle. 3. *Dermestes*. 4. *Coccinella*, lady-bird. 5. *Curculio*, weevil. 6. *Lampyris*, glow-worm. 7. *Meloe*, spanish fly. 8. *Staphylinus*. 9. *Forficula*, ear-wig.

Order 2. *Hemiptera*, or half winged insects. In this order, the wing-sheaths are tough or leathery at their upper part, and soft or membranaceous at the lower, and the real or under-wings are often of great size, and placed longitudinally in the manner of a fan. The genera are: 1. *Blatta*, cock-roach. 2. *Gryllus*, locust, grass-hopper. 3. *Fulgora*, lantern-fly. 4. *Cimex* bug, &c.

Order 3. *Lepidoptera*, or scaly winged insects. The powder, or down on the wings of these insects, has been considered as composed of a kind of feathers; but, in reality, it is composed of a kind of very minute scales, which differ in size and form in the different species, as well as on different parts of the same species. The genera are: 1. *Papilio*, butter-fly. 2, 3. *Sphinx* and *Phalæna*, moths.

Order 4. *Neuroptera*, or nerve-winged, or fibre-winged insects. This order consists of such as have four large wings, furnished with very conspicuous nerves, fibres, or ramifications dispersed over the whole wing. The genera are: 1. *Libellula*, dragon-fly. 2. *Ephemera*, may-fly, or trout-fly, &c.

Order 5. *Hymenoptera*, or insects having four wings, but not fibrous like the former order. They generally possess a sting or piercer which in some is innocent; but in others, it is calculated for the discharge of a highly acrimonious or poisonous juice, as in wasps and bees.

The genera are: 1. *Vespa*, wasp, hornet. 2. *Apis*, bee. 3. *Formica*, ant. 4. *Termes*, white ant. 5. *Ichneumon*, &c.

Orde[illegible] *Diptera*, consists of insects with two wi[illegible] only, as the whole race of flies strictly so called as well as gnats, and a great variety of other insects. The genera are: 1. *astrus*, gad-fly. 2. *Musca*, common flies. 3. *Culex*, gnat, musquito. 4. *Hippobosca*, horse-leech, &c.

Order 7 *Aptera*, or insects without wings. The genera are: 1. *Podura*, spring-sail. 2 *Pediculus*, louse. 3. *Pulex*, flea, chigger. 4 *Acarus*, tick, mite. 5. *Aranea*, spiders. 6. *Scorpio*, scorpion. 7. *Cancer*, crab, lobster craw-fish, shrimp. 8. *Monoculus*, water-flea.

9. *Oniscus*, wood-louse. 10. *Scolopendra*, centipede.

ENTOYER, in heraldry, denotes a bordure charged wholly with things without life: it seems to be a corruption of the French *entour*, round about.

ENTRY, *writ of*, is a writ directed to the sheriff, requiring him to command the tenant of the land, that he render to the demandant the premises in question, or appear in court on such a day, and shew why he has not done it.

ENVELOPE, in fortification, a work of earth, sometimes in form of a simple parapet, and at others, like a small rampart with a parapet; it is raised sometimes on the ditch, and sometimes beyond it.

ENUMERATION, in rhetoric, a part of the peroration, in which the orator, collecting the scattered heads of what has been delivered throughout the whole, makes a brief and artful relation, or recapitulation of it.

ENVOY, a person deputed to negociate some affair with any foreign prince or state. Those sent from the courts of France, Britain, Spain, &c. to any petty prince or state, such as the princes of Germany, the republics of Venice, Genoa, &c.

EPACRIS, in botany, a genus of the monogynia order, in the pentandria class of plants. There are four species, natives of New Holland.

EPACT, in chronology, a number arising from the excess of the common solar year above the lunar, by which the age of the moon may be found every year.

The excess of the solar year above the lunar is 11 days; or the epact of any year expresses the number of days from the last new moon of the old year, which was the beginning of the present lunar year, to the 1st of January. On the first year of the cycle of the moon, the epact is 0, because the lunar year begins with the solar. On the second, the lunar year has begun 11 days before the solar year, therefore the epact is 11. On the third, it has begun twice 11 before the solar year, therefore the epact is 22. On the fourth it begins three times 11 days sooner than the solar year, the epact would therefore be 33; but 30 days being a synodical month, must that year be intercalated; or that year must be reckoned to consist of 13 synodical months, and there remain three, which is the true epact of the year; and so on to the end of the cycle, adding 11 to the epact of the last year, and always rejecting 30, gives the epact of the present year. Thus, to adjust the lunar year to the solar, through the whole of 19 years, 12 of them must consist of 12 synodical months each, and 7 of 13, by adding a month of 30 days to every year when the epact would exceed 30, and a month of 29 days to the last year of the cycle, which makes in all 209 days, *i. e.* 19 × 11; so that the intercalary or embolimæan years in this cycle are 4, 7, 10, 12, 15, 18, 19.

EPAULEMENT, in fortification, a work raised to cover sidewise, is either of earth, gabions, or fascines, loaded with earth. The epaulements of the places of arms for the cavalry, at the entrance of the trenches, are generally of fascines mixed with earth.

EPHEDRA, in botany, a genus of the monodelphia order, in the diœcia class of plants and in the natural method ranking under the 51st order, coniferæ. There are two species, shrubs of Siberia.

EPHEMERA, the *day-fly*, or *May-fly*, in zoology, a genus belonging to the order of neuroptera. There are 11 species. These flies take their name of May-fly from the shortness of their life, and are distinguished into several species. Some live several days; others do not take flight till the setting of the sun, and do not even live to see him rise. Some exist but one hour, others but half that time. With respect to those that live several days, Mr. Barbut observes, there is a peculiarity incident to them. They have to cast off one slough more, an operation which sometimes takes 24 hours to complete. To effect this they cling fast to a tree. The ephemeræ, before they flutter in the air, have in some manner been fishes. They remain in the states of larva and chrysalis for one, two, or three years. The chrysalis only differs from the larva by there being observable on its back cases for wings. Both have on their sides small fringes of hair, which, when put into motion, serve them as fins. Nothing can be more curious than the plying of those little oars in the water. The abdomen is terminated, as well as in their state of flies, by three threads. These larvæ scoop themselves out dwellings in the banks of rivers; and they are small tubes made like siphons, the one serving for an entrance, the other affording them an outlet. The banks of some rivers are often perforated with them. When the waters decrease, they dig fresh holes lower down, in order to enjoy the water. The season and hour when the chrysalis of the different species of the ephemeræ turn into flies, maintain a kind of regularity. The heat, the rise or fall of the waters, accelerate, however, or postpone their final display. The ephemeræ of the Rhine appear in the air two hours before sunset. These flies are hatched almost all at the same instant in such numbers as to darken the air. The females, by the help of the threads of their tail and the flapping of their wings, support themselves on the surface of the water, and in that situation they drop their eggs in clusters. One female will lay 700 or 800 eggs, which sink to the bottom. The larvæ that escape the fish, set about the construction of habitations to shelter them from danger. When the flies have propagated, they are seen to die, and fall by heaps.

Ephemera, in medicine, the name of a species of fever continuing the space of one day, or sometimes more.

EPHEMERIDES, in astronomy, tables shewing the present state of the heavens for every day at noon; that is, the places wherein all the planets are found at that time. It is from these tables that the eclipses, conjunctions, and aspects of the planets, are determined; and horoscopes or celestial schemes constructed.

EPHIELIS, a genus of the class and order octandria monogynia. The calyx is five parted; petals five-clawed; nect. ten scales; capsule oblong. There is one species, a tree of Guiana.

EPIC, or *heroic poem*, a poem expressed in narration, formed upon a story partly real and partly feigned; representing in a sublime style, some signal and fortunate action, distinguished by a variety of great events, to form the

morals, and affect the mind with the love of heroic virtue.

EPICYCLOID, in geometry, a curve generated by the revolution of the periphery of a circle, along the convex or concave side of the periphery of another circle.

EPIDEMIC, in medicine, denotes those diseases which prevail at particular seasons, attacking many persons at the same time.

EPIDENDRUM, a genus of the diandria order, in the gynandria class of plants, and in the natural method ranking under the 7th order, orchideæ. There are 124 species, one of which is the plant which produces the fruit called vanilla, used in the making of chocolate. It is a native of Mexico, and also of some parts of the East Indies. The flowers are white, intermixed with stripes of red and yellow. When these fall off they are succeeded by the pods, which at first are green, but afterwards become yellow, and are gathered for use. The pods of the best vanilla are long, slender, and filled with seeds. If opened when fresh, the cavity is found to contain a humid substance, black, and balsamic, of such a strong smell, that it frequently causes headaches, and even intoxication.

EPIDERMIS, in anatomy, is the cutical or scarf skin.

EPIGRAM, a short poem, treating only of one thing, and ending with some lively, and natural thought, or point.

EPIGRAPHE among antiquarians, denotes the inscription on a building, pointing out the time when, the persons by whom, and the uses, for which it was erected.

EPILEPSY, in medicine, the same with what is otherwise called the falling-sickness, from the patient's falling suddenly to the ground.

EPILOBIUM, the *willow-herb*, in botany, a genus of the monogynia order, in the octandria class of plants; and in the natural method ranking under 17th order, calycanthemæ. There are fourteen species, several of them natives of Britain. They grow in marshes, or under hedges in moist and shady places; having blossoms generally of a red colour, and sometimes of considerable beauty. The most remarkable is the hirsutum, commonly called codlins and cream.

EPILOGUE, in dramatic poetry, a speech addressed to the audience after the play is over.

EPIMEDIUM, *barren-wort*, in botany, a genus of the monogynia order, in the tetrandria class of plants; and in the natural method ranking under the 24th order, corydales. There is only one species, viz. the alpinum. It is a low herbaceous plant, with a creeping root.

EPISODE, in poetry, a separate incident, story, or action, which a poet invents and connects with his principal action, that his work may abound with a greater diversity of events.

EPITAPH, a monumental inscription in honour or memory of a person defunct, or an inscription engraven or cut on a tomb, to mark the time of a person's decease, his name, family, and, usually, some eulogium of his virtues, or good qualities.

EPITHALAMIUM, in poetry, a nuptial song, or composition, in praise of the bride and bridegroom, praying for their prosperity, for a happy offspring, &c.

EPITHET, in poetry and rhetoric, an adjective expressing some quality of a substantive to which it is joined; or such an adjective as is annexed to substantives by way of ornament and illustration.

EPOCHA, in chronology, a term or fixed point of time, whence the succeeding years are numbered or accounted. See CHRONOLOGY.

EPODE, in lyric poetry, the third or last part of the ode, the ancient ode being divided into strophe, antistrophe, and epode.

EPOPOEIA, in poetry, the story, fable, or subject treated of, in an epic poem. The word is commonly used for the epic poem itself.

EPSOM *salt*, another name for sulphate of magnesia.

EQUABLE, an appellation given to such motions as always continue the same in degree of velocity, without being either accelerated or retarded.

EQUAL, a term of relation between two or more things of the same magnitude, quantity, or quality. Mathematicians speak of equal lines, angles, figures, circles, ratios, solids, &c.

EQUALITY, that agreement between two or more things whereby they are denominated equal. The equality of two quantities, in algebra, is denoted by two parallel lines placed between them: thus, $4+2=6$, that is, 4 added to 2 is equal to 6.

EQUANIMITY, in ethics, denotes that even and calm frame of mind and temper under good or bad fortune, whereby a man appears to be neither puffed up or overjoyed with prosperity, nor dispirited, soured, or rendered uneasy by adversity.

EQUATION. See ALGEBRA.

EQUATION, *of a curve*, an equation expressing the nature of a curve, the relation between an abscis and a corresponding ordinate, or the relation of their fluxions. See CURVE.

EQUATION *of time*, in astronomy and chronology, the reduction of the apparent time or motion of the sun, to equable, mean, or true time. See ASTRONOMY.

EQUATOR, in geography, a great circle of the terrestrial globe, equidistant from its poles, and dividing it into two equal hemispheres; one north and the other south. See GLOBES, *use of*.

EQUATORIAL, *universal*, or PORTABLE OBSERVATORY, is an instrument intended to answer a number of useful purposes in practical astronomy independent of any particular observatory. It may be employed in any steady room or place, and it performs most of the useful problems in the science of astronomy.

EQUERRY, in the British customs, an officer of state under the master of the horse. There are five equerries, who ride abroad with his majesty; for which purpose they give their attendance monthly, one at a time, and are allowed a table.

EQUES *auratus*, is used for a knight bachelor, called *auratus*, q. d. *gilt*, because anciently none but knights were allowed to beautify their armour, or other habiliments of war, with gold.

EQUESTRIAN *statue*, signifies the statue of a person mounted on horseback.

EQUESTRIAN *order*, among the Romans, signified their knights or equites, as also their troopers or horsemen in the field; the first of which orders stood in contradistinction to the senators, as the last did to the foot, military, or infantry: each of these distinctions was introduced into the state by Romulus.

EQUIANGULAR, in geometry, an epithet given to figures whose angles are all equal: such are a square, an equilateral triangle, &c.

EQUIDIFFERENT *numbers*, in arithmetic, are of two kinds. 1. Continually equidifferent is when, in a series of three numbers, there is the same difference between the first and second, as there is between the second and third; as 3, 6, 9. And 2. Discretely equidifferent is when, in a series of four numbers or quantities, there is the same difference between the first and second, as there is between the third and fourth: such are 3, 6, 7, 10.

EQUIDISTANT, an appellation given to things placed at an equal distance from some fixed point, or place, to which they are referred.

EQUILATERAL, in general, something that has equal sides, as an equilateral triangle.

EQUILIBRIUM, in mechanics, is when the two ends of a lever or balance hang so exactly even and level, as neither to ascend nor descend, but keep in a position parallel to the horizon; which is occasioned by their being both charged with an equal weight.

EQUIMULTIPLES, in arithmetic and geometry, are numbers of quantities multiplied by one and the same number or quantity. Hence, equimultiples are always in the same ratio to each other, as the simple quantities before multiplication.

EQUINOCTIAL, in astronomy, a great circle of the celestial globe, whose poles are the poles of the world. It is so called, because whenever the sun comes to this circle, the days and nights are equal all over the globe; being the same with that which the sun seems to describe, at the time of the two equinoxes of spring and autumn. All stars directly under this circle, have no declination, and always rise due east, and set full west. The hour circles are drawn at right angles to it, passing through every fifteenth degree; and the parallels to it are called parallels of declination.

EQUINOX, the time when the sun enters either of the equinoctial points, where the ecliptic intersects the equinoctial. It was evidently an important problem in practical astronomy, to determine the exact moment of the sun's occupying these stations; for it was natural to complete the course of the year from that moment. Accordingly this has been the leading problem in the astronomy of all nations. It is susceptible of considerable precision without the use of instruments. It is only necessary to observe the sun's declination on the noon of two or three days before and after the equinoctial day. On two consecutive days of this number, his declination must have changed from north to south, or from south to north. If his declination on one day was observed to be 21, north, and on the next 5, south, it follows that his declination was nothing, or that he was in the equinoctial point about 23 minutes after 7 in the morning of the second day. Knowing the precise moments, and knowing the rate of the sun's motion in the ecliptic, it is easy to ascertain the precise point of the ecliptic in which the equator intersected it. By a series of such observations made at Alexandria, between the years 161 and 127 before Christ, Hipparchus found that the point of the autumnal equinox was about six degrees to the eastward of the star called spica virginis. Eager to determine every thing by multiplied observations, he ransacked all the Chaldean, Egyptian, and other records, to which his travels could procure him access, for observations of the same kind; but he does not mention his having found any. He found, however, some observations of Aristillus and Timochares, made about 150 years before. From these it appeared evident that the point of the autumnal equinox was then about eight degrees east of the same star. He discusses these observations with great sagacity and rigour: and on their authority, he asserts that the equinoctial points are not fixed in the heavens, but move to the westward about a degree in 75 years.

This motion is called the precession of the equinoxes, because by it the time and place of the sun's equinoctial station precedes the usual calculations: It is fully confirmed by all subsequent observations. In 1750, the autumnal equinox was observed to be 20° 21′ westward of spica virginis. Supposing the motion to have been unform during this period of ages, it follows that the annual precession is about *$50\frac{1}{4}$*; that is, if the celestial equator cuts the ecliptic in a particular point on any day of this year, it will on the same day of the following year, cut it in a point $50\frac{1}{4}$° to the west of it, and the sun will come to the equinox 20′ 23″ before he has completed his round of the heavens. Thus the equinoctial, or tropical year, or true year of seasons, is so much shorter than the revolution of the sun or the sidereal year. It is this discovery that has chiefly immortalized the name of Hipparchus, though it must be acknowledged that all his astronomical researches have been conducted with the same sagacity and intelligence.

EQUULEUS, in astronomy, a constellation of the northern hemisphere, whose stars, according to Ptolemy and Tycho's catalogues, are four, but in Mr. Flamsteed's ten.

EQUUS, the horse, a genus of the mammalia class, of the order of belluæ. The generic character is, front teeth in the upper jaw six, parallel; in the lower jaw six, somewhat projecting; canine teeth, one on each side, in both jaws, remote from the rest; feet with undivided hoofs.

1. Equus caballus, or the common horse, the most noble and interesting of quadrupeds, is supposed to be found in a state of nature in several parts of Asia and Africa. In this state it is smaller than the domestic or tame animal, with a larger head, a more arched forehead, and the body thickly covered with pale-brown, or mouse-coloured hair.

Large herds of wild horses are said to be found about the lake Aral, near Kusneck, in lat. 54°; on the river Tom, in the southern parts of Siberia, and among the Kalkas, north-west of China. They are extremely swift, active, and vigilant; and, like some of the antelopes and other quadrupeds, have always a

sentinel, who gives notice to the herd on the approach of danger by a loud neigh; upon which they fly off with amazing rapidity.

Wild horses are found, according to Dr. Pallas, in the deserts on each side the river Don, towards the Palus Mæotis; but these are supposed to be the offspring of the Russian horses, which were employed in the siege of Asoph, in the year 1697, when for want of forage they were turned loose, and their descendants have gradually relapsed into the appearance of natural wildness.

The horse, in its domestic or improved state, is found in almost every part of the world, except perhaps within the Arctic circle; and its reduction and conquest may well be considered, as Buffon properly observes, as the greatest acquisition from the animal world ever made by the art and industry of men.

But no country has produced a breed of horses equal in size and strength to the larger kind of our draught horses. The cavalry of England is, in general, formed of this class of horses. The fens of Lincolnshire generally produce a larger breed than any other part of the kingdom. In our own country there seem to be no breed of horses naturally of a perfect white; those which are so termed having been first grey, changed through age to whiteness.

The most beautiful general colour seems to be bright bay, which gives an air of peculiar neatness and elegance to the animal. Black horses are commonly of large size, and in this country are chiefly used for the cart and the plough.

2. *Equus hemionus*, or jicta. This is a native of the desert regions between the rivers Onon and Argun, in the most southern parts of Siberia; and extends over the vast plains and deserts of Tartary, as well as that of Gobi, which reaches even to India. It shuns wooded and mountainous regions, and is said to live in small herds of about twenty each. Its general manners are those of the common wild horse; but its swiftness is still greater than that of the antelope.

This animal has an appearance much resembling that of a common mule; having a large head, flat forehead, middle-sized eyes, with ash-coloured irides; the ears are larger than in that species, erect, and lined with a thick, whitish, curling hair: the neck is slender and compressed: the mane upright, short, soft, and of a greyish colour. The winter coat of this animal is of a brownish ash-colour, with the tips of the hair grey. In summer it becomes much smoother, and in all parts elegantly marked by small featherings. The length of this species, from nose to tail, is about six feet and a half; that of the trunk of the tail sixteen inches.

3. *Equus asinus*, the ass. The ass, having been long condemned to a state of the lowest servitude, and considered as a species of less dignity than the horse, has acquired, in most parts of Europe, a character of contempt. Yet in its natural or wild state it exhibits an appearance very far superior both in point of beauty and vivacity. It is said to be found in Africa, and to occur, though but very rarely, in some parts of Syria and Arabia; countries where it was in ancient times extremely common. In its natural state its colour is said to be white, or a very pale silvery grey, with a slight tinge of straw-colour on the sides of the neck and body: along the back runs a deep-brown stripe of thickish wavy hair, to the beginning of the tail: this stripe is crossed over the shoulders, as in the tame animal, by another of similar colour; but it is said that this is peculiar to the male.

The food of the wild ass consists chiefly of saline, or bitter and lactescent plants. It is also fond of salt or brackish water. The manners of these animals very much resemble those of the wild horse. They assemble in troops, under the conduct of a leader or sentinel; and are extremely shy and vigilant, and dart off with the utmost rapidity on the sight of mankind. They have been at all times celebrated for their swiftness.

From this animal the domestic ass has been derived, which admits of considerable varieties. Those of the eastern parts of the world, as well as those of Africa, still partake, in a great degree, of the native elegance of their original or stock; and are very different from those commonly seen in the northern parts of Europe: for this animal seems to be much injured by the influence of a comparatively cold climate.

It may not be improper to observe, that the mule is nothing more than a hybrid animal, betweeen this species and the horse, differing in strength, size, and beauty, according to the predominacy of its parental species. Mules are very little used in this country, but in Spain and some other parts of Europe are in much esteem, and have deservedly the reputation of being remarkably sure footed.

4. *Equus zebra*, or the zebra, is a native of the hotter parts of Africa, being found from Æthiopia to the Cape of Good Hope, living in large herds, and possessing much of the manners both of the wild horse and the ass, being excessively swift and vigilant. It is of a still wilder or more unmanageable disposition than either of the former animals, and even such as have been taken very young are with much difficulty brought to any degree of familiarity, and have very rarely been rendered so far manageable as to submit to the bridle.

The size of the zebra is equal, or rather superior, to that of the ass, and its form more elegant; since, exclusive of its beautiful colours, the head and ears are well shaped, and of moderate size. The colour is either milk-white, or cream-colour, with a very slight cast of buff or pale ferruginous; and the whole animal is decorated on every part with very numerous black or blackish-brown stripes, disposed with the utmost symmetry, and exhibiting an appearance not easily described in words.

5. *Equus quagga*, or the quagga, which till lately was confounded with the zebra, is now acknowledged as a distinct species, much allied to the former, but marked with fewer and larger bands, which are of a browner colour than in the zebra, and are chiefly disposed on the fore parts of the animal, while the hind parts are rather spotted than striped. The ground-colour also of the quagga is of a ferruginous tinge, especially on the thighs and back. It is of a milder or more docile nature than the zebra, and is said to have been successfully used by some of the Dutch colonists at the Cape, in the manner of a horse, for draught, &c.

6. *Equus bisculus*, or cloven footed horse

The very name of this species seems to imply a kind of equivocal and anomalous being, one of the most prominent characters of the present genus being a simple or undivided hoof. It is very wild, strong, and swift and is found in the rocky regions of the Andes or Cordilleras of Peru and Chili. The hoofs are divided like those of ruminant animals.

ERANTHEMUM, a genus of the monogynia order, in the diandria class of plants, and in the natural method ranking with those of which the order is doubtful.

There are five species, herbs or under-shrubs of the Cape of Good Hope.

ERICA, *heath*, a genus of the monogynia order, in the octandria class of plants, and in the natural method ranking under the 18th order, bicornes. There are upwards of 100 species, four of them natives of Britain, which are so well known, that no description need be given of them. In the Highlands of Scotland this plant is made subservient to a great variety of purposes. The poorer inhabitants make walls for their cottages with alternate layers of heath and a kind of mortar made of black earth and straw. They make their beds of it, by placing the roots downwards; the tops being sufficiently soft to sleep upon. Cabins are also thatched with it. In the island of Ilay, ale is frequently made by brewing one part of malt and two of the tops of young heath, sometimes adding hops. Woollen cloth boiled in alum-water, and afterwards in a strong decoction of heath-tops, comes out of a fine orange-colour. The stalks and tops will tan leather. Besoms, and faggots to burn in ovens, are also made of this plant. Bees extract a great deal of honey from the flowers; and where heath abounds, the honey has a reddish cast.

ERIDANUS, in astronomy, a constellation of the southern hemisphere, containing, according to different authors, 19, 30, or even 84 stars.

ERIGERON, *flea-bane*, a genus of the polygamia superflua order, in the syngenesia class of plants, and in the natural method ranking under the 49th order, compositæ. There are 30 species, of which the most remarkable is the viscosum. It is a native of the south of France and Italy; and has a perennial root, whence arise many upright stalks near three feet high. The flowers are produced single upon pretty long footstalks, are of a yellow colour, and have an agreeable odour.

ERINACEUS, *hedgehog*, a genus of quadrupeds of the order of feræ.

The species are: 1. *Erinaceus Europæus*, common or European hedgehog. The hedgehog is found in most of the temperate parts of Europe and is also seen in Madagascar. It commonly measures about 11 inches from the nose to the tip of the tail, which is about an inch long. Its colour is generally grey-brown, but it sometimes is found totally white. It feeds principally on the roots of vegetables; but it also eats worms, as well as beetles and other insects. It wanders about chiefly by night, and during the day conceals itself in its hole, under the roots of some tree, or mossy bank. It produces four or five young at a birth, which are soon covered with prickles like those of the parent animal. The nest is large, and is composed of moss.

The hedgehog, when disturbed, rolls itself up into a globular form, and thus presents to its adversary an invulnerable ball of prickles. From this state of security, it is not easily forced; scarce any thing but cold water obliging it to unfold itself. It swims well when thrown into water.

The hedgehog is, during the winter, supposed to continue in a state of torpidity. It may be rendered domestic; and has frequently been introduced into houses for the purpose of expelling the blattæ, or cockroaches, of which it is fond.

2. *Erinaceus inauris*. Earless hedgehog. This, on a general view, seems to be nothing more than a variety of the common hedgehog, differing chiefly, in having the spines on the upper parts of the body shorter, thicker, and stronger; the head shorter, and the snout blunter than in the common hedgehog, and there is no appearance of external ears; the whole animal is also of a white or pale colour. Its length from nose to tail is about eight inches; the tail scarcely an inch long; the claws long and crooked.

3. *Erinaceus auritus*. Long-eared hedgehog. This species resembles the common hedgehog in form, and is found about the river Volga, and in the eastern parts beyond lake Baikal. In its general manner of life this species is said to resemble the common hedgehog. The female produces six or seven young at a time, and is said sometimes to breed twice a year.

4. *Erinaceus Madagascariensis*. Striped hedgehog. This animal, which is a native of Madagascar, is of a black colour, with five longitudinal bands on the body; all the black parts are covered with hard hair; the white bands with small prickles, like those of a porcupine. From the black bands on the back, spring long scattered hairs which reach to the ground; the head is covered with short black hairs or prickles; the snout is white; the eye surrounded by a white circle, and the feet are reddish. They burrow under ground, and live chiefly on fruits and herbs.

5. *Erinaceus Malaccensis*. Malacca hedgehog. This species has completely the appearance of a procupine; but Brisson considered it as a species of hedgehog; and Linnæus, in compliance with his opinion, transferred it from the genus hystrix to that of erinaceus.

ERINUS, a genus of the angiospermia order, in the didynamia class of plants, and in the natural method ranking under the 40th order, personatæ. There are 13 species, none of them natives of Britain.

ERIOPHORUM, a genus of the monogynia order, in the triandria class of plants, and in the natural method ranking under the third order, calamariæ. There are six species, nearly allied to the grasses, only two are natives of Britain.

ERITHALIS, a genus of the monogynia order, in the pentandria class of plants, and in the natural method ranking with those of which the order is doubtful. There are two species, trees of Jamaica and the Society Isles.

ERMIN. See MUSTELA.

ERMIN, in heraldry, is always argent and sable, that is, a white field, or fur, with black spots.

ERMINE, or *cross ermine*, is one composed of four ermine spots; the colours in these arms are not to be expressed, because neither this cross nor these arms can be of any other colour than white and black.

ERNODIA, a genus of the class and order tetrandria monogynia. There is one species, a creeping plant of Jamaica.

ERODIUM, *crane's bill*, a genus of the class and order monodelphia pentandria, and in the natural method of the other gruinales. This genus is vulgarly confounded with the geranium: indeed there are three genera, which have the same habits, but differing in the number of stamina. This plant has five, the geranium seven, and the pelasconium, or African geranium, ten. Of the erodium there are 28 species including at least three which are natives of Britain.

ERODIUS, a genus of insects of the order of coleoptera. The antennæ are moniliform; feelers, filiform; body roundish, gibbous. immarginate; thorax, transverse; shells closely united, longer than the abdomen; jaw horny, bifid; lip horny, emarginate. There are four species.

EROTEUM, a genus of the class and order pentandria monogynia. There are two species, natives of Jamaica.

ERROR, in law, signifies an error in pleading, or in the process; and the writ which is brought for remedy thereof, is called a *writ of error*

ERUCA, in general, denotes caterpillars of all kinds. The caterpillar state is that through which every butterfly must pass before it arrives at its perfection and beauty. The change from caterpillar to butterfly was long esteemed a real change of one animal into another; but this is by no means the case. The egg of a butterfly produces a butterfly with all the lineaments of its parent; only these are not disclosed at first, but for the greater part of the animal's life they are covered with a sort of case or muscular coat, in which are legs for walking: these only suit it in this state; but its mouth takes in nourishment, which is conveyed to the included animal: and after a proper time this covering is thrown off, and the butterfly, which all the while might be discovered in it by an accurate observer with the help of a microscope, appears in its proper form. Before it passes into this state, however, there requires a state of rest for the wings to harden, and the several other parts to acquire their proper firmness; this is transacted in a time of perfect rest, when the animal lies in what is called the nymph or chrysalis state, in appearance only a lump of inanimate matter. There is a settled and determined time for each of these changes in every species; but in the several different kinds, the periods are different.

There is no sign of sex in the animal while in the caterpillar state: the propagation of the species is the business of the creature in its ultimate perfection; one female butterfly, when she has been impregnated by the male, will produce 300 or 400 eggs, or even more. The females are always larger than the males; they are also more slow in their motions; and some of them have no wings, or at the most only very small ones.

The care of all the butterfly tribe to lodge their eggs in safety is surprising. Those whose eggs are to be hatched in a few weeks, and who are to live in the caterpillar state during part of the remaining summer, always lay them on the leaves of such plants as will afford a proper nourishment: but, on the contrary, those whose eggs are to remain unhatched till the following spring, always lay them on the branches of trees and shrubs, and usually are careful to select such places as are least exposed to the rigour of the ensuing season, and frequently cover them from it in an artful manner. Some make a general coat of a hairy matter over them; others hide themselves in hollow places in trees, and other cells, and there live in a kind of torpid state during the winter, that they may deposit their eggs in the succeeding spring.

It is well known that the common food of these creatures is the leaves and verdure of vegetables; yet, as harmless as they seem, they will many of them destroy their fellows whenever they get an opportunity. These species, however, though freed from such dangers, are exposed to others of a more terrible kind; the worms or maggots of several sorts of flies are frequently found about them, some preying upon their outside, others lodged within them under the skin, but both kinds eating the creature up alive.

Nothing is more surprising in insects than their industry: and in this the caterpillars yield to no kind, not to mention their silk, the spinning of which is one great proof of it. The cases which some of these insects build for passing their transformations under, are by some made with their own hair, mixed with pieces of bark, leaves, and other parts of trees, with paper, and other materials. There is one which builds in wood, and is able to give its case a hardness greater than that of the wood itself in its natural state. This is the horned caterpillar of the willow, which is one of these that eat their exuviæ. This creature has sharp teeth, and with these it cuts the wood into small fragments; these it unites together into a case, of what shape it pleases, by means of a viscous juice, which hardens as it dries, and is a strong and firm cement.

The butterfly, as soon as hatched, discharges a liquor which softens the viscous matter that holds the case together; and so its several fragments, falling to pieces, it escapes.

Another very curious artifice is, that by which some species of caterpillars, when the time of their changing into the chrysalis state is coming on, make themselves lodgments in the leaves of the trees, by rolling them up in such a manner as to form a sort of hollow cylindric case, proportioned to the thickness of their body, well defended. Besides those caterpillars, which roll up the leaves of plants, there are other species which only bend them once, and others, which by means of thin threads, connect many leaves together to make them a case.

Caterpillars are very destructive to gardens, particularly those of two species. The one that which afterwards becomes the common white butterfly. This is of a yellowish-white colour, spotted with black, and infests the leaves of cabbages, cauliflowers, and the Indian

cress, of which it eats off all the tender parts, leaving only the fibres entire. There is no remedy against this evil but the pulling the creatures off before they are spread from their nests, and watching the butterflies, which are daily, in the hot weather, depositing their eggs on these plants.

Erucæ *aquaticæ, water-caterpillars.* M. Reaumur, in his observations, met with two species of these; the one upon the pond-weed, the other upon the lenticula or duck-meat. These are both very industrious animals; but the first being much the largest, its operations are more easily distinguished. This, though an aquatic animal, swims but badly, and dislikes the water. The parent butterfly lays her

This it carries to another part of the same leaf, and lays it in such a manner, that there may be a hollow between, in which it may lodge. It then fastens down this piece to the larger leaf with silk of its own spinning, only leaving holes

since a little force from its body bends up the upper leaf and down the lower, both being flexible; and when the creature is out, it has a sort of down that defends it from being wetted, and the natural elasticity of the leaves and silk joins the aperture again, so that no water can get in. The leaves of this kind of plant are also naturally slippery, and not easily wetted by water. The changes of this creature into the chrysalis and butterfly states are in the common method. The butterfly gets out of a chrysalis which was placed on the surface of the water; the lightness of the animal sustains it on the water till its wings are dried, and then it leaves that element, never to return to it again.

Erucæ *sylvestres,* wood caterpillars, do not live on leaves of trees or plants, but under the bark, in the trunk and branches, and in the roots of trees, and sometimes in the body of fruits.

Of these species, some go out of their prison to change into their chrysalis, and thence into their butterfly state; but the greater number remain there, and pass through all their changes within. These caterpillars, like all the other kinds, have certain flesh-eating worms, whose parents are of the fly-kind, for their destroyers; and it is not unfrequent, on opening one of these spoiled fruits, instead of the caterpillar, to find a fly just ready to come out: this has been produced from the chrysalis of a worm, which had found its way into the fruit, and eaten up the original possessor of the place.

ERUCTATIONS, in medicine, are the effect of flatulent foods, and the crudities thence arising.

ERUPTION, in medicine, a sudden and copious excretion of humours, as pus or blood; it signifies also the same with exanthema, any breaking out; as the pustules of the plague, small-pox, measles, &c.

ERVUM, the lentil, a genus of the decandria order, in the diadelphia class of plants, and in the natural method ranking under the 32nd order, papilionaceæ. There are six species; of which the most remarkable is the lens, or common lentil. It is cultivated in many parts of England, either as fodder for cattle, or for the seeds, which are frequently used in meagre soups. It is an annual plant, and rises with weak stalks about 18 inches high, with winged leaves composed of several pairs of narrow lobes, terminated by a clasper or tendril, which fastens to any neighbouring plant, and is thereby supported; the flowers come out three or four together, upon short footstalks from the side of the branches. They are small, of a pale purple colour, and are succeeded by short flat pods, containing two or three seeds which are flat, round, and a little convex in the middle.

There is another sort of lentil also cultivated

cultivation than the other.

ERYNGIUM, sea-holly, or eryngo, a genus of the digynia order, in the pentandria class of plants; and in the natural method ranking under the 45th order, umbellatæ. The flowers are

ducing erect stalks from one to two or three feet high: with simple, entire, or divided prickly leaves; and the stalks terminated by roundish, aggregate heads of quinquepetalous flowers of white, blue, or purple colours. They all flower mostly in July, and the seeds ripen in September.

ERYSIMUM, hedge-mustard; a genus of the siliquosa order, in the tetradynamia class of plants; and in the natural method ranking under the 39th order, siliquosæ. The *siliqua* is long, linear, and exactly tetragonal; the calyx close. There are eight species; of which the most remarkable is the officinale, hedge-mustard, or bank cresses. It grows naturally in Britain under walls by the sides of highways, and among rubbish.

ERYSIPELAS, in medicine, an eruption of a fiery or acrid humour, from which no part of the body is exempted, though it chiefly attacks the face.

ERYTHRINA, coral-tree; a genus of the decandria order, in the diadelphia class of plants; and in the natural method ranking under the 32nd order, papilionaceæ. There are seven species, all of them shrubby flowering exotics for the stove, adorned chiefly with trifoliate or three-lobed leaves, and scarlet spikes of papilionaceous flowers. They are all natives of the warm parts of Africa and America.

ERYTHRONIUM, dog's tooth violet, a genus of the monogynia order, in the hexandria class of plants; and in the natural method ranking under the 11th order, sarmentaceæ. There is only one species; which, however, admits of several varieties in its flowers, as white, purple, pale red, dark red, crimson, and yellow. The plants are low and herbaceous, with a purple stalk and hexapetalous flowers.

ERYTHROXYLON, a genus of the trigynia order, in the decandria class of plants; and in the natural method ranking in the doubtful order. There are five species, beautiful shrubs of the West Indies.

ESCALADE, in war, a furious attack of a wall or a rampart; carried on with ladders, to

pass the ditch or mount the rampart, without proceeding in form, breaking ground, or carrying on regular works to secure the men. Since the invention and use of gunpowder, and the walls of cities have been flanked, they are seldom taken by escalade.

ESCALLONIA, a genus of the monogynia order, in the pentandria class of plants. The fruit is bilocular and polyspermous; the petals distant and tongue-shaped; and stigma headed. There are two species, shrubs of the West Indies and South America.

ESCAPE, in law, is where one, who is arrested, gains his liberty before he is delivered by course of law.

Escapes are either in civil or criminal cases; and in both respects may be distinguished into voluntary, and negligent; voluntary, where it is with the consent of the keeper; negligent, where it is for want of due care in him. In civil cases, after the prisoner has been suffered voluntarily to escape, the sheriff can never retake him, but must answer for the debt; but the plaintiff may retake him at any time. In the case of a negligent escape, the sheriff, upon fresh pursuit, may retake the prisoner; and the sheriff shall be excused, if he has him again before any action brought against himself for the escape.

ESCAPEMENT. See SCAPEMENT.

ESCHALOT. See ALLIUM.

ESCHEAT, in our law, denotes an obstruction of the course of descent, and a consequent determination of the tenure, by some unforeseen contingency; in which case, the land naturally results back, by a kind of reversion, to the original grantor or lord of the fee.

ESCLATTE, in heraldry, signifies a thing forcibly broken, or rather a shield that has been broken and shattered with the stroke of a battle-ax.

ESCUTCHEON, in heraldry, is derived from the French *escusson*, and that from the Latin *scutum*, and signifies the shield whereon coats of arms are represented.

ESCUTCHEON *of pretence*, that on which a man carries his wife's coat of arms; being an heiress, and having issue by her. It is placed over the coat of the husband, who thereby shows his pretensions to her lands.

ESOX, *pike*, a genus of fishes of the order abdominales. The generic character is, head somewhat flattened above, mouth wide; teeth sharp, in the jaws, palate, and tongue; body lengthened; dorsal and anal fin (in most species) placed near the tail, and opposite each other. There are nine species, of which the most remarkable are:

1. *Esox lucius*, or common pike. It is, says Pennant, a native of most of the lakes and smaller rivers in Europe, but the largest are those of Lapland, which are sometimes eight feet in length: they are taken there in great abundance, dried, and exported for sale. The largest specimen of English growth is said to have weighed thirty five pounds. The head of the pike is very flat; the upper jaw broad, and shorter than the lower, which turns up a little at the end, and is marked with minute punctures: the teeth are very sharp, disposed only in front of the upper jaw, but in both sides of the lower, as well as in the roof of the mouth, and often on the tongue: the number, is not less than seven hundred, without reckoning those nearest the throat: it is also to be observed that those which are situated on the jaws are alternately fixed and moveable; the gape is very wide, and the eyes small. The usual colour of this fish is a pale olive-grey, deepest on the back, and marked on the sides by several yellowish spots or patches: the abdomen is white, slightly spotted with black.

The voracity of the pike is commemorated by all ichthyological authors. Mr. Pennant observes that he has known a pike that was choaked in attempting to swallow one of its own species. It will also devour water-rats, and young ducks which happen to be swimming near it.

The longevity of the pike is very remarkable, if we may credit the accounts given by authors. Rzaczynski in his Natural History of Poland tells us of one that was ninety years old; but Gesner relates that in the year 1497, a pike was taken near Hailburn, in Suabia, with a brass ring affixed to it, on which were these words in Greek characters: "I am the fish which was first of all put into this lake by the hands of the governor of the universe, Frederic the Second, the fifth of October 1230."

The pike spawns in March and April according to the warmth or coldness of the season; depositing its ova among the weeds, &c. near the water's edge: the young are said to be of very quick growth.

2. *Esox sphyræna*, or sea-pike. This species is of a silvery blueish colour, dusky on the back, and slightly tinged with yellow on the head and about the gills: the first dorsal fin is situated on the middle of the back, and is furnished with only four rays; the second, which is placed opposite the anal fin, consists of about ten rays; both these dorsal fins, together with the tail, which is deeply forked, are of a dusky tinge; the pectoral, ventral, and anal, are of a pale red, the eyes are moderately large. This fish is an inhabitant of the Mediterranean and Atlantic seas, growing to the length of about two feet.

3. *Esox barracuda*, or barracuoa pike, has the habit of the common pike; the size is very great, some having been seen of ten feet in length; but the more common size is from six to eight feet. This is said to be an extremely strong, fierce, and dangerous fish, swimming with great rapidity, and preying on most others; it is even said sometimes to attack and destroy bathers, in the same manner as the shark. It is found in great plenty in the tropical seas, and about the West Indian islands.

4. *Esox vulpes*, or the fox pike. Its general length is about sixteen inches: habit somewhat similar to that of a common pike, but remarkably slender or taper towards the tail, which is very deeply and widely forked; mouth of moderate width: jaws equal, and with a single row of sharp teeth in each: dorsal fin situated in the middle of the back; scales rather large, thin, and roundish: colour of the whole fish brown, native of Carolina and the West Indian islands.

5. *Esox Malabaricus*, or Malabar pike, is in length about twelve inches; habit distantly allied to that of the common pike, but with the tail rounded, and the dorsal fin placed on the middle of the back, colour yellowish, dusky on the back; lower jaw longer than the

upper; eyes rather large; scales large, and very distinct.

6. *Esox bellona*, gar fish, or sea-needle, is well known by its protracted snout, and the bones, which are green when boiled.

ESPALIERS, in gardening, are rows of trees trained up regularly to a lattice of wood-work in a close hedge, for the defence of tender plants against the injuries of wind and weather.

ESPLANADE, in fortification, the sloping of the parapet of the covered way towards the campaign. It is the same with glacis, and is more properly the empty space betwixt a citadel and the houses of a town, commonly called a place of arms.

ESQUIRE was anciently the person that attended a knight in the time of war, and carried his shield. This title has not, for a long time, had any relation to the office of the person, as to carry arms, &c. Those to whom the title of esquire is now of right due, are all noblemen's younger sons, and the eldest sons of such younger sons; the eldest sons of knights, and their eldest sons; the officers of the king's courts, and of his household: counsellors at law, justices of the peace, &c. though those latter are only esquires in reputation: besides, a justice of the peace holds this title no longer than he is in commission in case he is not otherwise qualified to bear it; but a sheriff of a county, who is a superior officer, retains the title of esquire during life, in consequence of the trust once reposed in him; the heads of some ancient families are said to be esquires by prescription.

ESSENCE, in chemistry, denotes the purest, most subtile, and balsamic parts of a body; extracted either by simple expression, or by means of fire, from fruits, flowers, and the like. Of these there is a great variety, used on account of their agreeable smell and taste, by apothecaries, perfumers, and others.

ESSOIN, in law, an excuse for a person summoned to appear and answer to an action on account of sickness or other just cause of his absence.

ESSOIN-*day*, is regularly the first day of every term, though the fourth day after is also allowed by way of indulgence.

ESTATE, in law, signifies such inheritance, freehold, term for years, tenantcy by statute-merchant, staple, elegit, or the like, as any man has in lands and tenements. Estates are real, of lands, tenements, &c. or personal, of goods or chattels: otherwise distinguished into freeholds that descend to the heir, and chattels which go to the executors.

ESTOILEE', or *cross estoilee*, in heraldry, a star with only four long rays in form of a cross; and, accordingly, broad in the centre, and terminating in sharp points.

ESTOPPEL, in law, an impediment or bar to an action, which arises from a person's own act; or rather, where he is forbidden by law to speak against his deed, which he may not do, even to plead the truth.

ESTOVERS, in law, is a liberty of taking necessary wood for the use or furniture of a house or farm. And this any tenant may take from off the land let or demised to him.

ESTRAYS and WAIFS. Estrays are any valuable beasts, not wild, found within a lordship whose owner is not known; such as are commonly impounded and not claimed. They are then to be proclaimed in the church and the two nearest market-towns, on two market-days, and not being claimed by the owner, belong to the king, and now commonly by grant of the crown, to the lord of the manor, or the liberty. Beasts *ſeræ naturæ*, cannot be estrays.

ESTREAT, is a true copy or note of some original writing on record, and especially of fines and amercements imposed in the rolls of a court, and extracted or drawn out thence, and certified into the Court of Exchequer.

ETCHING, is a manner of engraving on copper, in which the lines or strokes, instead of being cut with a tool or graver, are corroded in with aqua-fortis.

In almost all the engravings on copper that are executed in the stroke manner, etching and graving are combined, the plate being generally begun by etching, and finished with the graver. Landscapes, architecture, and machinery, are the subjects that receive most assistance from the art of etching; for it is not so applicable to portraits and historical designs. See ENGRAVING.

ETHER, a very volatile fluid produced by the distillation of alcohol with an acid. Ether is of various kinds, according to the acid used in its production; but that which has been longest known, and is most in demand is the sulphuric ether.

The method of procuring this substance is as follows. Put into a retort a convenient quantity of alcohol, and add an equal weight of strong sulphuric acid; the whole must be mingled as intimately as possible by a gentle agitation.

The retort must now be placed in a sand bath, and connected with a large receiver, kept cool by being surrounded with ice, if it can be obtained, or placed in water. The first product is a fragrant spirit of wine; and as soon as the fluid in the retort begins to boil, the ether comes over. At this period of the process the upper part of the receiver is covered with large distinct streams of the fluid which run down its sides. There should be a bent glass tube luted to the tubulure of the receiver, and having its extremity immersed in water or mercury, to allow the gases to escape, and the more effectually to confine the condensible vapour.

After the ether a light yellow oil, called oil of wine, comes over: and this is followed by black and foul sulphuric acid. Great care is necessary, on the part of the operator, in extracting ether, as from its extreme inflammability, the danger of explosion attending the sudden mixture and agitation of alcohol with concentrated acids; and the suffocating effect of the elastic fluids, which, if disengaged, might fill the apartment, serious accidents sometimes happen. Sulphuric ether acts upon most of the resinous substances; it dissolves the essential oils and camphor; and burns with a more luminous flame than alcohol, producing more smoke. It boils at the temperature of 98° Fahr.; and in evaporating produces extreme cold. In medicine it is extensively useful.

ETHICS, or *morality*, the science of manners or duty, which it traces from man's nature and condition, and shews to terminate in his happiness; or, in other words, it is the knowledge of our duty and felicity, or the art of being virtuous and happy.

ETHMODIAL, in anatomy, one of the common sutures of the skull, which goes round the os ethmoides, from which it derives its name, separating it from the bone in contact with it.

ETHULIA, a genus of the class and order syngenesia polygamia æqualis. The receptacle is naked; down none. There are six species, chiefly annuals of the East Indies.

ETHUSA, fool's parsley. See ÆTHUSA.

ETNA. See VOLCANO.

ETYMOLOGY, that part of grammar which considers and explains the origin and derivation of words, in order to arrive at their first and primary signification, whence Quintilian calls it *originatio*. See GRAMMAR.

EVAPORATION. A chemical operation usually performed by applying heat to any compound substance, in order to dispel the volatile parts. It differs from distillation in its object, which chiefly consists in preserving the more fixed matters, while the volatile substances are dissipated and lost. And the vessels are accordingly different; evaporation being commonly made in open shallow vessels, and distillation in an apparatus nearly closed from the external air.

The degree of heat must be duly regulated in evaporation. When the fixed and more volatile matters do not greatly differ in their tendency to fly off, the heat must be very carefully adjusted; but in other cases this is less necessary.

As evaporation consists in the assumption of the elastic form, its rapidity will be in proportion to the degree of heat, and the diminution of the pressure of the atmosphere. A current of air is likewise of service in this process.

EUCALYPTUS, a genus of the hexandria monogynia class and order. There are two species; lofty trees of New Holland; called also the red-gum tree, from a gummy matter, in which one of them, the resinifera, abounds. A single tree will, on being tapped, afford more than 60 gallons of juice.

EUCLEA, a genus of the diœcia dodecandria class and order. There is one species, a branching tree of the Cape.

EUCOMIS, a genus of the class and order hexandria monogynia. There are four species, plants of the Cape.

EUDIOMETER. An instrument for ascertaining the purity of air, or rather the quantity of oxygen contained in any given bulk of elastic fluid. Dr Priestly seems to be the original inventor of this instrument; but it has been much improved since his day by the ingenuity of Dr. Hope of Edinburgh, and Dr. Ure of Glasgow. The contrivance of Dr. Ure seems entitled to general preference from its combining the desirable properties of simplicity, convenience, cheapness, safety. and precision.

EVERGREEN, in gardening, a species of perennials which continue their verdure, leaves, &c. all the year; such are hollies, phillyria's, laurustinus's, bays, pines, firs, cedars of Lebanon, &c.

EVERLASTING *pea*, the name of a perennial plant of the vetch kind, which grows naturally in some places, is easily cultivated, annually yields plenty of excellent provender, and may be cultivated to advantage as green food for cattle, on almost any strong soil.

EVES *droppers*, or EAVES *droppers*, persons who listen under walls or windows, or the eaves of a house, by night or day, to hear news, and to carry them to others to cause strife among neighbours; and who may be presented at the leet, or bound to their good behaviour, and punished by stat. Westminster, 1. c. 33.

EVIDENCE, is the testimony adduced before a court or magistrate of competent jurisdiction.

This may be of two kinds, viz. written or verbal: the former by deeds, bonds, or other written documents; the latter by witnesses examined *viva voce*.

Evidence may be further divided into absolute and presumptive; the former is direct, in positive or absolute affirmance or denial of any particular fact; the latter collateral, and from the conduct of the parties, affords an inference that such a particular fact did or did not occur.

EVOLUTION. See ALGEBRA.

EVOLUTION, in the art of war, the motion made by a body of troops, when they are obliged to change their form and disposition, in order to preserve a post, or occupy another, to attack an enemy with more advantage, or to be in a condition of defending themselves the better.

EVOLVULUS, a genus of the tetragynia order, in the pentandria class of plants; and in the natural method ranking under the 29th order, campanaceæ. There are seven species, herbaceous plants, chiefly annuals of the East and West Indies.

EUPATORIUM, hemp-agrimony; a genus of the polygamia æqualis order, in the syngenesia class of plants; and in the natural method ranking under the 49th order, compositæ. There are 49 species, many of them herbaceous flowery perennials, producing annual stalks from two to three or five feet high, terminated by clusters of compound flowers of a red, purple, or white colour. One species, viz. the cannabinum, or water hemp-agrimony, is a native of Britain. It is found wild by the sides of rivers and ditches, and has pale red blossoms.

EUPHONY, in grammar, an easiness, smoothness, and elegance in pronunciation. It is properly a figure, whereby we suppress a letter that is too harsh, and convert it into a smoother, contrary to the ordinary rules; of this there are abundance of examples in all languages.

EUPHORBIA, spurge, a genus of the trigynia order, in the dodecandria class of plants; and in the natural method ranking under the 38th order, tricoccæ. There are 98 species, six of which are natives of Great Britain. They are mostly shrubby and herbaceous succulents, frequently armed with thorns, having stalks from ten to twelve inches to as many feet in height, with quadri-petalous flowers of a whitish or yellow colour. There is a species at the Cape, which supplies the Hottentots with an ingredient for poisoning their arrows.

EUPHRASIA, eyebright (from a vulgar notion that it was good in disorders of the eyes;) a genus of the angiospermia order, in the didynamia class of plants; and in the na-

tural method ranking under the 40th order, personatæ. There are nine species; two of which annuals, viz. the officinalis and adonties, are natives of Britain. The first of these, which has blue flowers, is a weak astringent, and was formerly much celebrated in disorders of the eyes; but the present practice has disregarded its use.

EURYTHMY, in architecture, painting, and sculpture, is a certain majesty, elegance, and easiness, appearing in the composition of divers members, or parts of a body, painting, or sculpture, and resulting from the fine proportion of it. Vitruvius ranks the eurythmia among the essential parts of architecture; he describes it as consisting in the beauty of the construction, or assemblage of the several parts of the work, which renders its whole appearance beautiful.

EXACUM, a genus of the monogynia order, in the tetrandria class of plants, and in the natural method ranking under the 20th order, rotaceæ. There are 10 species, allied to the gentians, chiefly annuals, of the East Indies and Cape.

EXAGGERATION, in rhetoric, a kind of hyperbole, whereby things are augmented or amplified, by saying more than the truth, either as to good or bad. There are two kinds of exaggeration; the one of things, the other of words.

EXCELLENCY, a title anciently given to kings and emperors, but now to ambassadors and other persons, who are not qualified for that of "highness," and yet are to be elevated above the other inferior dignities.

EXCENTRIC, in geometry, a term applied to circles and spheres which have not the same centre, and consequently are not parallel; in opposition to concentric, where they are parallel, having one common centre.

EXCENTRICITY, in astronomy, is the distance of the centre of the orbit of a planet from the centre of the sun, that is, the distance between the centre of the ellipsis and the focus.

EXCEPTION, in law, is a stop or stay to any action. In law proceedings, it is a denial of a matter alleged in bar to an action; and in Chancery, it is what is alleged against the sufficiency of an answer.

EXCHANGE, in law, is a mutual grant of equal interests, the one in consideration of the other.

In exchange, the estates of both parties should be equal; that is, if the one has a fee-simple in the one land, the other should have a like estate in the other land: and if the one has fee-tail in the one land, the other ought to have the like estate in the other land; and so of other estates.

Exchange, in arithmetic and commerce, is the reduction of different coins of any denominations of money from one to another: or it is the method of finding how many of one species or denomination are equal to a given number of another; in order to which it is necessary to know the value of the coins of different countries, and the proportion to each other according to the settled rate of exchange. The several operations in this case are only different applications of the rule of three. It is obvious that the true par of exchange must be subject to frequent fluctuation from the variations that take place in the comparative value of gold and silver; and also from the alterations frequently made in the value of the coins of different countries.

To remedy the inconveniencies arising from these and other causes that necessarily operate in extensive commerce, lists of the courses of exchange are issued from the principal trading places in Europe. These lists are called *Quotations*, and may always be obtained at the Royal Exchange. Lloyd's list exhibits the quotation at London.

As the subject of exchanges is generally introduced into respectable treatises on arithmetic, and thus rendered accessible to all at an easy rate, it is deemed unnecessary to occupy our pages with it: the necessary tables, together with suitable rules for the various operations, specimens of quotations, &c. are amply exhibited in Keith's Complete Practical Arithmetician. The reader will also find an able article on exchanges in Dr. Kelly's Elements of Book-keeping; but the most complete work of this nature in the English language, is the Universal Cambist, by the last-named author, which is founded on the celebrated German work of Kruse, intitled the Hamburgh Contorist.

EXCHEQUER, from the French *eschequier*. i. e. *abacus tabula lusoria*, is a court of law and equity, established by William the Conqueror, as a part of the *aula regis*; but reduced to its present state by Edward I. and intended principally to order the revenue of the crown, and to recover the king's debts and duties. The court consists of two divisions, viz. the receipt of the exchequer, which manages the royal revenues; and the judicial, which is again subdivided into a court of equity, and a court of common law. The court of equity is held in the Exchequer, before the Lord Treasurer, the Chancellor of the Exchequer, the Chief Baron, and three puisne Barons.

EXCISE *duties*, inland taxes on commodities of general consumption. This mode of taxation, having been always found very productive, has been adopted by all the European governments, and by some of them has been extended even to the necessaries of life; but, in general, the articles subjected to it have been such as are not absolutely essential to subsistence. Salt appears to have been the object of an excise duty at a very early period: in later times oil, wine, tobacco, and various other consumable articles have been burthened with duties of this description.

EXCLAMATION, in rhetoric, a figure that expresses the violent and sudden breaking out, and vehemence of any passion. Such is that in the second book of Milton's Paradise Lost.

> "O unexpected stroke! worse than of death,
> Must I thus leave thee, Paradise? Thus leave
> Thee, native soil; these happy walks and shades,
> Fit haunt of gods!"

Other figures are the language of some particular passion, but this expresses them all.

EXCOECARIA, a genus of the triandria order, in the dioecia class of plants; and in the natural method ranking under the 38th order, tricoccæ. There are two species. The agallocha, or aloes wood, is a native of China

and some of the Indian islands, and is about the same height and form as the olive-tree. Its trunk is of three colours, and contains three sorts of wood; the heart is that of tambac, or calombac, which is dearer in the Indies than even gold itself.

EXCOMMUNICATION, an ecclesiastical penalty or censure whereby such persons as are guilty of any notorious crime or offence, are separated from the communion of the church, and deprived of all spiritual advantages.

EXCORIATION, in medicine and surgery, the galling or rubbing off of the cuticle.

EXCRESCENCE, in surgery, denotes every preternatural tumour which arises upon the skin, either in the form of a wart or tubercle.

EXCRETION, or SECRETION, in medicine, a separation of some fluid, mixed with the blood, by means of the glands.

EXCRETORY, in anatomy, a term applied to certain little ducts or vessels, destined for the reception of a fluid, secreted in certain glandules, and other viscera, for the excretion of it in the appropriated places.

EXECUTION is a judicial writ, grounded on the judgment of the court whence it issues; and is supposed to be granted by the court at the request of the party at whose suit it is issued, to give him satisfaction on the judgment which he has obtained: and therefore an execution cannot be sued out in one court, upon a judgment obtained in another.

Executions in actions where money is recovered, as a debt or damages, are of five sorts: 1. Against the body of the defendant; 2. against his goods or chattels; 3. against his goods and the profits of his lands; 4. against the goods and the possession of his lands; 5. against all three, his body, lands, and goods.

EXECUTION *of criminals*, must be according to the judgment; and the king cannot alter a judgment from hanging to beheading, because no execution can be warranted, unless it is pursuant to the judgment.

Execution of criminals is the completion of human punishment; and this in all cases, as well capital as otherwise, must be performed by the legal officer, the sheriff or his deputy.

EXECUTOR, is a person appointed by the testator, to carry it to execution his will and testament after his decease. The regular mode of appointing an executor, is by naming him expressly in the will; but any words indicating an intention of the testator to appoint an executor will be deemed a sufficent appointment.

EXEGESIS, In the Scotch universities there is an exercise among the students in divinity called an exegesis, in which a question is stated by the respondent, who is then opposed by two or three other students in their turns; during which time the professor moderates, and solves the difficulties which the respondent cannot overcome.

EXEMPLIFICATION *of letters patent*, a transcript or a duplicate of them, made from the enrolment thereof, and sealed with the great seal.

EXERCISE, among physicians, such an agitation of the body as produces salutary effects in the animal economy. Exercise may be said to be either active or passive. The active is walking, hunting, dancing, playing at bowls and the like; as also speaking, and other labour of the body and mind; the passive is riding in a coach, on horseback, or in any other manner.

EXERCISE, in military affairs, is the practice of all those motions and actions, together with the whole management of arms, which a soldier is to be perfect in, to render him fit for service, and make him understand how to attack and defend.

EXHALATION, a general term for all the effluvia or steams raised from the surface of the earth in form of vapour. Some distinguish exhalations from vapours, expressing by the former all steams emitted from solid bodies, and by the latter the steams raised from water and other fluids.

EXHAUSTIONS, or *the method of exhaustions*, a method of demonstration founded upon a kind of exhausting a quantity, by continually taking away certain parts of it.

The method of exhaustions was of frequent use among the ancient mathematicians, as Euclid, Archimedes, &c. It is founded on what Euclid says in the 10th book of his Elements, viz. that those quantities are equal whose difference is less than any assignable quantity.

EXIGENT, in law, signifies a writ or part of the process of outlawry on civil actions.

EXISTENCE, has been defined:—a state of being; actual possession of being. Mr. Locke says:—"We arrive at the knowledge of our own existence by intuition; of the existence of God by demonstration; and of other things by sensation. As for our own existence," continues that great philosopher, "we perceive it so plainly, that it neither needs, nor is capable of any proof. I think, I reason, I feel pleasure and pain; can any of these be more evident to me than my own existence? If I doubt of all other things, that very doubt makes me perceive my own existence, and will not suffer me to doubt it. If I know I doubt, I have as certain a perception of the thing doubting, as of that thought which I call doubt: experience then convinces us that we have an intuitive knowledge of our own existence."

From the knowledge of our own existence, Mr. Locke deduces his demonstration of the existence of a God.

EXOCOETUS, or the *flying-fish*, in ichthyology, a genus belonging to the order of abdominales. The head is scaly, and it has no teeth; it has 10 radii in the branchiostege membrane; the body is whitish, and the belly is angular; the pectoral fins are very large. When pursued by any other fish, it raises itself from the water by means of these long fins, and flies in the air to a considerable distance, till the fins dry, and then it falls down into the water. It is a fish that seems to lead a most miserable life. In its own element it is perpetually harassed by the dorados and other fish of prey. If it endeavours to avoid them by having recourse to the air, it either meets its fate from the gulls or the albatross, or is forced down again into the mouths of the inhabitants of the water, who below keep pace with its aerial excursions. This fish is caught in the Mediterranean and some other seas, but is most common between the tropics.

EXORDIUM, in rhetoric, is the preamble

or beginning, serving to prepare the audience for the rest of the discourse.

EXOTIC, an appellation denoting a thing to be the produce of foreign countries. Exotic plants of the hot climates are very numerous, and require the utmost attention of the gardener to make them thrive with us.

EXPANSION, denotes an increase of the bulk of any body by a power acting from within.

It may be laid down as a general rule, to which there is no known exception, that every addition or abstraction of caloric makes a corresponding change in the bulk of the body which has been subjected to this alteration in the quantity of its heat. In general, the addition of heat increases the bulk of a body, and the abstraction of it diminishes its bulk; but this is not uniformly the case, though the exceptions are not numerous.

Though all bodies are expanded by heat and contracted by cold, and this expansion in the same body is always proportional to some function of the quantity of caloric added or abstracted, yet the absolute expansion, or contraction, has been found to differ exceedingly in different bodies. In general, the expansion of gaseous bodies is greatest of all; that of liquids is much smaller, and that of solids the smallest of all. Thus, 100 cubic inches of atmospheric air, by being heated from the temperature of 32° to that of 212°, are increased to 137.5 cubic inches; while the same augmentation of temperature only makes 100 cubic inches of water assume the bulk of 101.5 cubic inches; and 100 cubic inches of iron, when heated from 32° to 212°, assume a bulk scarcely exceeding 100.1 cubic inches. From this example, we see that the expansion of air is more than eight times greater than that of water, and the expansion of water about 45 times greater than that of iron.

EX PARTE, a term used in the Court of Chancery, when a commission is taken out and executed by one side or part only, upon the other party's neglecting or refusing to join therein. When both the parties proceed together, it is called a joint commission.

EXPECTATION, in the doctrine of chances, is applied to any contingent event, upon the happening of which some benefit, &c. is expected. This is capable of being reduced to the rules of computation; for a sum of money in expectation when a particular event happens, has a determinate value before that event happens. Thus, if a person is to receive any sum as 10*l.* when an event takes place which has an equal chance or probability of happening or failing, the value of the expectation is half that sum, or 5*l.*; but if there are three chances for failing, and only one for its happening, or one chance only in its favour out of all the four chances, then the probability of its happening is only one out of four, or $\frac{1}{4}$, and the value of the expectation is but $\frac{1}{4}$ of 10*l.* which is only 2*l.* 10*s.* or half the former sum. And in all cases, the value of the expectation of any sum is found by multiplying that sum by the fraction expressing the probability of obtaining it. So the value of the expectation on 100*l.* when there are three chances out of five for obtaining it, or when the probability of obtaining it is three fifth part of 100*l.* which is 60*l.* And if s be any sum expected on the happening of an event, h the chances for that event happening, and f the chances for it failing; then, there being h chances out of $f+h$ for its happening, the probability will be $\frac{h}{f+h}$, and the value of the expectation is $\frac{h}{f+h} \times s$.

EXPECTORANTS, an appellation given to those medicines which facilitate the discharging the cont[illegible] of the lungs.

EXPECTORATION, the act of evacuating or bringing up phlegm, or other matters out of the trachea, lungs, &c. by coughing, hanking, spitting, &c.

EXPERIMENTAL *philosophy*, that philosophy which deduces the laws of nature, and the properties and powers of bodies, and their actions upon each other, from sensible experiments and observations.

In our enquiries into nature, we are to be conducted by those rules and maxims which are found to be genuine, and consonant to a just method of physical reasoning; and these rules of philosophizing are by the greatest master in science, Sir Isaac Newton, reckoned four, which are as follows:

1. More causes of natural things are not to be admitted, than are both true, and sufficient to explain the phænomena; for nature does nothing in vain, but is simple, and delights not in superfluous causes of things.

2. And, therefore, of natural effects of the same kind, the same causes are to be assigned, as far as it can be done; as of respiration in man and beasts, of the descent of stones in Europe and America, of light in a culinary fire and in the sun, and of the reflection of light in the earth and in the planets.

3. The qualities of natural bodies which cannot be increased or diminished, and agree to all bodies on which experiments can be made, are to be reckoned as the qualities of all bodies whatever; thus, because extension, divisibility, hardness, impenetrability, mobility, the vis inertiæ, and gravity, are found in all bodies which fall under our inspection, we may justly conclude they belong to all bodies whatever, and are therefore to be esteemed the original and universal properties of all natural bodies.

4. In experimental philosophy, propositions collected from the phænomena by induction, are to be deemed (notwithstanding contrary hypotheses) either exactly or very nearly true, till other phænomena occur, by which they may be rendered either more accurate, or liable to exception. This ought to be done, lest arguments of induction should be destroyed by hypotheses.

EXPERIMENTUM CRUCIS, a leading, or decisive experiment; thus termed, either on account of its being like a cross, or direction post, placed in the meeting of several roads, guiding men to the true knowledge of the nature of that thing they are enquiring after; or, on account of its being a kind of torture, whereby the nature of the thing is in a manner extorted by force.

EXPLOSION, in natural philosophy, a sudden and violent expansion of an aerial, or other elastic fluid, by which it instantly throws off any obstacle that happens to be in the way, sometimes with incredible force, and in such a

manner as to produce the most astonishing effects. It differs from expansion in this, that the latter is a gradual and continued power, acting uniformly for some time, whereas, the former is always sudden, and only of momentary duration. The expansions of solid bodies do not terminate in violent explosions, on account of their slowness, and the small space through which the metal, or other expanding substance, moves. Thus wedges of dry wood driven into stone, and wetted, will cleave the most solid blocks; but they never throw the parts to any distance, as is the case with gunpowder; but the expansion of elastic fluids will burst solid substances, and throw the fragments a great way off: for this, two reasons have been assigned: 1. The immense velocity with which aerial fluids expand, when suddenly affected with high degrees of heat: and 2. The great celerity with which they acquire heat, and are affected by it. As an example: air when heated as much as iron, when brought to a white heat, is expanded to four times its bulk, but the metal itself will not be expanded the 500dth part of the space. In the case of gunpowder, which is well known as an explosive substance, the velocity with which the flame moves is estimated at 7000 feet in a second. Hence the impulse of the fluid is inconceivably great, and the obstacles on which it strikes are hurried off with vast velocity, *viz.* at the rate of 27 miles per minute. The velocity of the bullet is also promoted by the sudden propagation of the heat through the whole body of air, as soon as it is extricated from the materials of which the gunpowder is made, so that it strikes at once. Hence it has been inferred, that explosion depends first on the quantity of elastic fluid to be expanded: secondly, on the velocity it acquires by a certain degree of heat; and thirdly, on the celerity with which the degree of heat affects the whole expansile fluid.

EXPONENT, in *algebra*, is the same with index. See ALGEBRA.

EXPORTATION, in commerce, is the act of sending goods out of one country into another, by shipping, or otherwise.

EXPRESSED *oils*, in chemistry, such oils as are obtained from bodies only by pressing. See OIL.

EXPRESSION, in chemistry, or pharmacy, denotes the act of pressing out the juices or oils of vegetables, which is one of the three ways of obtaining them; the other two being by infusion and decoction.

EXPRESSION, in painting, is the distinct exhibition of character in the general object of the work, or of sentiment in the characters or persons represented.

In the latter case it consists either in representing the body in general and all its parts severally, in actions most peculiarly suitable to the design of the picture, and marking thereby the emotions of the soul in the various figures, or in pourtraying in the face the appearances of the passions.

EXTENSION, in philosophy, one of the common and essential properties of body, or that by which it possesses or takes up some part of universal space, which is called the place of that body.

EXTENSOR, an appellation given to several muscles, from their extending or stretching the parts to which they belong.

EXTENT, in law, a writ of execution or commission to the sheriff, of one who being bound by statute, has forfeited his bond, for the valuing of lands or tenements; sometimes the act of the sheriff upon this writ.

EXTERMINATION, in general, the extirpating or destroying something. In algebra, surds, fractions, and unknown quantities, are exterminated by the rules for reducing equations.

EXTRACT. When decoction is carried to such a point as to afford a substance either solid or of the consistence of paste, this residual product is called an extract. When chemists speak of extract, they most commonly mean the product of aqueous decoction; but the earlier chemists frequently speak of spirituous extract.

Extracts thus prepared are mixtures of several of the materials of vegetables, whence they differ greatly, according to the plants from which they are obtained; but modern chemists distinguish by the name of extract, or *extractive matter*, a peculiar substance, supposed to be one of the immediate materials of vegetables, and the same in all, when separated from any foreign admixture, except as the proportion of its constituent principles may vary.

EXTRACTION, in surgery, is the drawing any foreign matter out of the body by the hand, or by the help of instruments.

EXTRACTOR, in midwifery, an instrument, or forceps, for extracting children by the head.

EXTRAVASATION, in contusions, fissures, depressions, fractures, and other accidents of the cranium, is when one or more of the blood-vessels that are distributed on the dura mater, are broken or divided, whereby there is such a discharge of blood as greatly oppresses the brain, and disturbs its offices; frequently bringing on violent pains and other mischiefs, and at length death itself, unless the patient is relieved.

EXTREMES, in logic, the terms expressing the two ideas whose relation we enquire after in a syllogism.

EXUVIÆ, among naturalists, denote the cast-off parts or coverings of animals, as the skins of serpents, caterpillars, and other insects. See ERUCA.

EYE, in anatomy, the organ of sight, or that part of the body whereby visible objects are represented to the mind.

The term eye is used in a great variety of senses. In architecture, it signifies an aperture at the top of a dome, also the centre of a volute: in agriculture, it means either a little bud or shoot, ingrafted into a tree, or the part of a potatoe cut off for seed and in printing it is used for the graving in relievo on the top of the letter. In a symbolical sense, there is no term of which so much use is made to denote the operations of the understanding and the affections.

F.

F, The sixth letter of the alphabet, and the fourth consonant. It has much the same sound as the Greek φ, or *ph* in English words, and is only written in words of Latin origin, *ph* being used instead of it in words derived from the Greek.

As a numeral, F denotes 40, and with a dash over it thus $\bar{F}$, 40,000: in music, it stands for the bass clef; and frequently for *forte*, as *ff* does for *forte forte*.

As an abbreviation, F stands for *filius*, *fellow*, and the like: thus F. R. S. signifies Fellow of the Royal Society.

FA, in music, one of the syllables invented by Guido Aretine, to mark the fourth note of the modern scale, which rises thus, *ut*, *re*, *mi*, *fa*.

Musicians distinguish two *fa's*, *viz.* the flat, marked with a ♭, or ♭; and the sharp or natural, marked thus ♮, and called biquadro.

FABLE is used for the plot of an epic or dramatic poem, and is, according to Aristotle, the principal part, and, as it were, the soul of a poem.

FACE, comprehends all that part of the head which is not covered with the common long hair. See ANATOMY.

Face, or *facade*, in architecture, the front of a building, or the side which contains the chief entrance.

Face, in fortification, an appellation given to several parts of a fortress, as the face of a bastion, &c.

FACET, or *facette*, among jewellers, the name of the little faces or planes to be found in brilliant and rose diamonds.

FACTITIOUS, any thing made by art, in opposition to what is the produce of nature. Thus, factitious cinnabar is opposed to native cinnabar.

FACTOR, in commerce, is an agent or correspondent residing beyond the seas, or in some remote part, commissioned by merchants to buy or sell goods on their account, or assist them in carrying on their trade.

FACTORAGE, called also commission, is the allowance given to factors by the merchant who employs them.

FACTORY is a place where a considerable number of factors reside, to negotiate for their masters or employers. The most considerable factories belonging to the British are those established in the East Indies, Portugal, Turkey, &c.

FACULÆ, in astronomy, certain bright and shining parts, which the modern astronomers have, by means of telescopes, observed upon or about the surface of the sun: they are but very seldom seen.

Hevelius assures us that, on July 20, 1634, he observed a facula, the breadth of which was equal to a third part of the sun's diameter. He says too that the maculæ often change into faculæ, but these seldom or never into maculæ. And some authors even contend that all the maculæ degenerate into faculæ before they quite disappear. Many authors, after Kircher and Scheiner, have represented the sun's body full of bright, fiery spots, which they conceive to be a sort of volcanoes in the body of the sun; but Huygens, and others of the latest and best observers, finding that the best telescopes discover nothing of the matter, agree entirely to explode the phænomena of faculæ. All the foundation he could see for the notion of faculæ, he says, was, that in the darkish clouds which frequently surround the maculæ, there are sometimes seen little points or sparks brighter than the rest.

FACULTY, in law, a privilege granted to a person, by favour and indulgence, of doing what, by law, he ought not to do. For granting these privileges there is a court under the archbishop of Canterbury, called the court of the faculties.

Faculty, in the schools, a term applied to the different members of a university, divided according to the arts and sciences taught there: thus, in most universities there are four faculties: viz. 1. Of arts, which include humanity and philosophy. 2. Of theology. 3. Of physic. And 4. Of civil law. The degrees in the several faculties in our universites are those of bachelor, master, and doctor.

Faculty *of advocates*, a term applied to the college or society of advocates in Scotland, who plead in all actions before the court of session. They meet in the beginning of every year, and choose the annual officers of the society, viz. dean, treasurer, clerks, private and public examinators, and a curator of their library.

Faculty is also used to denote the powers of the human mind, viz. understanding, will, memory, and imagination.

FÆCES, in chemistry, the gross matter, or sediment, that settles at the bottom after distillation, fermentation, &c.

FÆCULA. See GLUTEN.

FAGARA, *iron wood*, a genus of the monogynia order, in the tetrandria class of plants, and in the natural method ranking under the 43 order, dumosæ. There are 10 species, all natives of the warm parts of America, rising with woody stems more than 20 feet high.

FAGG, in the sea language, a term given to the end of those strands which do not go through the tops, when a cable or rope is closed.

FAGONIA, a genus of the monogynia order, in the decandria class of plants, and in the natural method ranking under the 14th order, gruinales. There are three species, herbaceous plants of Spain, Crete, and Arabia.

FAGRÆA, a genus of the class and order pentandria monogynia. There is one species, a shrub of Ceylon.

FAGUS, the *beech-tree*, a genus of the polyandria order, in the monœcia class of plants; and in the natural method raking under the 50th order, amentaceæ. There are five species. The most remarkable are,

1. The *sylvatica*, or beech-tree, rises 60 or 70 feet high, and has a proportionable thickness,

branching upward into a fine regular head, with oval serrated leaves, with flowers in globular catkins, succeeded by angular fruit called mast.

2. The *castanea*, or chesnut-tree, has a large upright trunk growing 40 or 50 feet high, branching regularly round into a fine spreading head, with large spear-shaped acutely serrated leaves, naked on the under side, having flowers in long amentums, succeeded by round prickly fruit, containing two or more nuts.

3. The *pumila*, dwarf chesnut-tree, or chinkapin, rises eight or ten feet high, with a braching shrubby stem, and oval-spear shaped and acutely serrated leaves, hoary on the under side. The wood of the beech tree, in point of usefulness, ranks next to the oak and the ash, and is much used by cabinet-makers and turners. The mast, or seeds yield a good oil for lamps; and are eaten by squirrels and swine.

FAILLIS, in heraldry, a French term denoting some failure or fraction in an ordinary, as if it were broken, or a splinter taken from it.

FAIR, a greater kind of market, granted to a town, by privilege, for the more speedy and commodious providing of such things as the place stands in need of.

FAIRY-*circle*, or *ring*, a phænomenon frequent in the fields, &c. supposed by the vulgar to be traced by the fairies in their dances: there are two kinds of it; one of about seven yards in diameter, containing a round bare path, a foot broad, with green grass in the middle of it. The other is of different bigness, encompassed with a circumference of grass, greener and fresher that that in the middle. Messrs. Jessop and Walker, in the Philosophical Transact. ascribed them to lightning: we have however examined them ourselves, and are convinced they are produced by a kind of fungus which breaks and pulverizes the soil; why this vegetable should put forth its offsets in this kind of circular direction we cannot rightly account. The circles however are seldom complete, and often very irregular.

FALCO, in ornithology, a genus belonging to the order of accipitres, the characters of which are these: the beak is crooked, and furnished with wax at the base; the head is thick-set with feathers, and the tongue is cloven. The eagle, kite, and hawk, form this genus. There are 32 species, of which the following are the most remarkable.

1. The *leucocephalus*, bald, or white-headed eagle of Catesby, is ash-coloured, with head and tail white; the iris of the eye is white, over which is a prominence covered with a yellow skin; the bill and the cere or wax are yellow, as are likewise the legs and feet; and the talons are black. Though it is an eagle of small size, it weighs nine pounds, is strong and full of spirit, preying on lambs, pigs, and fawns. They always make their nests near the sea or great rivers, and usually upon old dead pine or cypress trees, continuing to build annually on the same tree till it falls.

2. The *ossifragus*, *sea-eagle*, or osprey with yellow wax, and half feathered legs It is about the size of a peacock; the feathers are white at the base, iron coloured in the middle, and black at the points; and the legs are yellow. It is found in several parts of Great Britain and Ireland. All authors indeed agree, hat it feeds principally on fish, which it takes as they are swimming near the surface, by darting down upon them; not by diving or swimming, as some have pretended. Martin, speaking of what he calls the great eagles of the Western Isles, says, that they fasten their talons in the back of the fish, commonly of salmon, which are often above the water, or very near the surface. Those of Greenland will even take a young seal out of the water.

3. The *chrysaetos*, or golden eagle, weighs about twelve pounds, and is in length about three feet, the wings when extended measuring about seven feet four inches. The sight and sense of smelling are very acute: the head and neck are clothed with narrow sharp-pointed feathers, of a deep-brown colour bordered with tawny; the hind part of the head in particular is of a bright rust-colour. These birds are very destructive to fawns, lambs, kids, and all kinds of game, particularly in the breeding season, when they bring a vast quantity of prey to their young. Smith, in his History of Kerry, relates, that a poor man in that county got a comfortable subsistence for his family, during a summer of famine, out of an eagle's nest by robbing the eaglets of the food which the old one brought; whose attendance he protracted beyond the natural time, by clipping the wings and retarding the flight of the former.

Eagles are remarkable for their longevity, and for their power of sustaining a long abstinence from food. Mr. Keysler relates, that an eagle died at Vienna after a confinement of 104 years. This pre-eminent length of days probably gave occasion to the saying of the Psalmist, "Thy youth is renewed like the eagle's."

4. The *fulvus*, or white-tailed eagle of Edwards, has the whole plumage of a dusky-brown: the breast marked with triangular spots of white, but which are wanting in the British kind: the tail is white, tipped with black; but in young birds dusky, blotched with white: the legs are covered to the toes with soft rust-coloured feathers. These birds inhabit Hudson's-bay and northern Europe as far as Drontheim.

5. The *cyaneus*, or hen-harrier, with white wax, yellow legs, a whitish-blue body, and a white ring round the eyes and throat. It is the blue hawk of Edwards, and is a native of Europe and Africa. These birds are extremely destructive to young poultry and to the feathered game; they fly near the ground, skimming the surface in search of prey.

6. The *albicilla*, or cinereous eagle, is inferior in size to the golden eagle; the head and neck are of a pale ash-colour; the body and wings cinereous, clouded with brown; the quill feathers very dark; the tail white; the legs feathered but little below the knees, and of a very bright yellow. The male is of a darker colour than the female. This species is in size equal to the black eagle, and inhabits Europe as high as Iceland and Lapmark. It is common in Greenland, but does not extend to America; or, if it does, it varies into the white-headed eagle, to which it has great affinity.

7. The *maculatus*, or the crying eagle, with a dusky bill and yellow cere: the colour of the

plumage is a ferruginous brown; the coverts of the wings and scapulars are elegantly varied with white spots; the primaries dusky, the ends of the greater white; the breast and belly are of a deeper colour than the rest of the plumage, streaked downwards with dull yellow; the tail is dark brown, tipped with dirty white; the legs are feathered to the feet, which are yellow. The length of the bird is two feet. This species is frequent in Russia and Siberia; and extends even to Kamschatka. It is less generous and spirited than other eagles, and is perpetually making a plaintive noise. The Arabs used to train it for the chase; but its quarry was cranes and other birds, the more generous eagle being flown at antelopes and other quadrupeds.

8. The *milvus*, or kite, is a native of Europe, Asia, and Africa. This species generally breeds in large forests or woody mountainous countries. Its nest is composed of sticks, lined with several odd materials, such as rags, bits of flannel, rope, and paper. Its motion in the air distinguishes it from all other birds, being so smooth and even that it is scarcely perceptible. Sometimes it will remain quite motionless for a considerable space; at others glide through the sky without the least apparent action of its wings. They inhabit the north of Europe, as high as Jalsberg, in the very south of Norway; but do not extend farther. They quit Sweden in flocks at the approach of winter, and return in spring. Some of them winter about Astrakan; but the far greater part are supposed to retire into Egypt, being seen in September passing by Constantinople in their way from the north; and again in April returning to Europe, to shun the great heats of the East. They are observed in vast numbers about Cairo, where they are extremely tame, and feed even on dates, probably for want of other food.

9. The *gentilis*, or gentil falcon, inhabits the north of Scotland, and was in high esteem as a bold and spirited bird in the days of falconry. It makes its nest in rocks; it is larger than the gos-hawk; the head of a light rust-colour, with oblong black spots; the under side white, tinged with yellow; the back of a brown colour; the tail barred with black, and ash-colour; the tips of all the tail feathers white.

10. The *subbuteo*, or hobby, was used like the kestrel in the humbler kind of falconry; particularly in what was called daring of larks: the hawk was cast off; the larks, aware of their enemy, were fixed to the ground for fear; by which means they became a ready prey to the fowler, who drew a net over them. The back of the bird is brown: the nape of the neck white: and the belly pale, with brown spots. It is a bird of passage; but breeds in Britain, and migrates in October.

11. The *buteo*, or buzzard, is the most common of the hawk kind in England. It breeds in woods; and usually builds on an old crow's nest, which it enlarges, and lines with wool and other soft materials. It lays two or three eggs, which are sometimes perfectly white, sometimes spotted with yellow. The cock-buzzard will hatch and bring up the young if the hen is killed. The young keep company with the old ones for some little time after they quit the nest; which is not usual with other birds of prey who always drive away their brood as soon as they can fly. The buzzard is very inactive, and is much less in motion than other hawks; remaining perched on the same bough for the greatest part of the day, and dwelling at most times near the same place. It feeds on birds, rabbits, moles, and mice; it will also eat frogs, earthworms, and insects. This bird is subject to some variety in its colour. Some have the breast and belly of a brown colour, and are only marked across the craw with a large white crescent; but usually the breast is of a yellowish white, spotted with rust-coloured spots, pointing downwards; the back of the head, neck, and coverts of the wings, are of a deep brown, edged with a pale rust-colour: the middle of the back covered only with a thick white down. The tail is barred with black and ash-colour, and sometimes ferruginous.

12. The *columbarius*, or pigeon-hawk of Catesby, weighs about six ounces. The bill is black at the point, and whitish at the base: the iris of the eye is yellow; the base of the upper mandible is covered with a yellow cere of wax: all the upper part of the body, wings, and tail, are brown. The anterior vanes of the quill-feathers have large red spots. The tail is marked with large regular transverse white lines; the throat, breast, and belly, are white, mixed with brown: the small feathers that cover the thighs reach within half an inch of the feet, and are white, with a tincture of red, beset with long spots of brown; the legs and feet are yellow. It inhabits America, from Hudson's-bay as low as South Carolina.

13. The *palumbarius*, with black wax edged with yellow, yellow legs, a brown body, the prime feathers of the tail marked with pale streaks, and the eye-brows white. It is the gos-hawk of Ray, and was formerly in high esteem among falconers, being flown at cranes, geese, pheasants, and partridges. It breeds in Scotland, and builds its nest in trees. It is destructive to game, and dashes through the woods after its quarry with vast impetuosity; but if it cannot catch the object of its pursuit almost immediately, desists, and perches on a bough till some new game presents itself. This species is common in Muscovy and Siberia.

Besides these we may mention the lithofalco, or stone falcon, which inhabits many parts of Europe, and is about a foot long; the bill blueish-ash; irides yellow; two middle tail-feathers uniform, the rest barred with brown: the gallicus or French eagle, so called from its being found chiefly in France, about two feet long, feeds on rats, mice, and frogs; it builds its nest mostly on the ground, the irides yellow; tail feathers white with brown transverse stripes, brown at the tips and edges; claws grey: the latter inhabits Europe, Tartary in Asia, and many parts of North America; it is two feet long, patient of cold; used in hunting the white heron: the head pale brown; wing-coverts and primary quill feathers with transverse white lines; tail brown, with oval transverse red spots on the sides; legs feathered to the toes: and the magnirostris, or great billed falcon, found in Cayenne, a little larger than the sparrow-hawk; legs shorter; bill longer, thicker, black; irides orange; feathers above and on the breast brown edged with rusty; claws black.

There are some other species distinguished by ornithologists. Among these are two described by Mr. Bruce; of which one deserves particular notice, as being not only the largest of the eagle kind, but supposed to be the largest bird that flies. He calls it the golden eagle; by the natives it is vulgarly called abon duchn, or father long-beard.

FALCONRY, the art of training all manner of hawks, but more especially the larger sort, called falcons, to the exercise of hawking.

FALL, in the sea language, that part of the rope of a tackle, which is hauled upon.

Also when a ship is under sail, and keeps not so near the wind as she should do, they say she falls off.

FALLOPIAN *tubes*, two canals of a tortuous figure, but approaching to a conic form, joined to the fundus of the uterus, one on each side.

FALSE, in music, an epithet applied by theorists to certain chords, called false, because they do not contain all the intervals appertaining to those chords in their perfect state; as a fifth, consisting of only six semitonic degrees, is denominated a false fifth.

FALX, in anatomy, a process of the dura mater, placed between the two hemispheres of the brain, and resembling a reaper's sickle.

FAMES *canina*, an excessive appetite. See Bulimy.

FAMILY, denotes the persons that live together in one house, under the direction of one head or chief manager. It also signifies the kindred or lineage of a person, and is used by old writers for a hide or portion of land sufficient to maintain one family.

Family, in natural history, a term used by authors to express any order of animals, or other natural productions of the same class.

FAN, an instrument used in winnowing corn.

FARINA, a term given to the pulverulent and glutinous part of wheat and other seeds, obtained by grinding and dressing.

FARM or Ferm, signifies the chief messuage in a village, or any large messuage to which land belongs, meadow, pasture, wood, common, &c. and which has been used to let for term of life or years, under a certain yearly rent payable by the tenant for the same.

FARRIER, is the designation of the smith who devotes his attention chiefly to shoeing horses, and to curing them of all kinds of diseases. It was probably owing to the opportunities afforded to the smiths, while shoeing horses, of observing the various diseases of the foot, and consequently of haranguing on the subject, that they, in time, acquired an undue reputation for perfect ability in not only that particular, but for a general knowledge of whatever related to the animal at large.

FARRIERY, the art and profession of the farrier, which have comprehended, from the earliest even to the present period, the medical and surgical care of the horse, as well as that of manufacturing and fitting him with shoes. These men, as labourers of iron, were originally termed ferrers, or ferriers, from the Latin word *ferrum*, iron, and their craft ferriery; which word has since, either by a very usual corruption or improvement of language, been changed to farriery. This term remains yet in general use to its fullest extent, and not inaptly; since notwithstanding the laudable attempts of many enlightened men at various periods, our blacksmiths form a very large majority of horse surgeons and physicians. Nor is such defect peculiar to this country, but prevails throughout Europe.

On the establishment of a college, about fourteen years since, for the instruction of pupils in animal medicine and surgery, we imported from France the term *veterinary*, and the veterinary art has been since substituted for farriery by practitioners of liberal education. The supposed derivation of the term veterinary is from the participle *vectum*, of the Latin word *veho*, to carry; *quasi*, vecterinary, thence applied to the care of animals which carry.

For a more particular view of the subject of farriery the reader is referred to the article Veterinary Art.

FASCES, in Roman antiquity, axes bound up together with rods or staves, and carried before the Roman magistrates as a badge of their authority and office.

FASCIÆ, in astronomy, certain parts on Jupiter's body resembling belts or swaths. They are more lucid than the rest of that planet, and are terminated by parallel lines, sometimes broader, and sometimes narrower.

FASCINES, in fortification, faggots of small wood of about a foot diameter, and six feet long, bound in the middle, and at both ends.

FASCIOLA, in zoology, the *fluke* or gourd worm: a genus of insects of the order of vermes intestinæ; of which the characters are these: The body is flattish, and has a vent-hole at the extremity and on the belly. There are several species. 1. The hepatica, or liver-fluke, grows to two-thirds of an inch in length, though it is more usually met with not half that size. It bears some resemblance to the seed of the common gourd, whence it has acquired the name of the gourd worm. It is found in fresh waters, in ditches, at the roots of stones, sometimes in the intestines, and often in the substance of the other viscera in quadrupeds. It often infests the liver of sheep, and on that account is called hepatica. Bags with salt in them, placed in the fold, that the sheep may lick them, is a good remedy. 2. The intestinalis, or intestinal fluke, inhabits the intestines of fresh-water fish, especially the bream. 3. The barbata, is white, with transverse papillæ in the mouth. It is of an oblong shape, and about the size of a cucumber-seed.

FAT, in anatomy, an oleaginous or butyraceous matter, secreted from the blood, and filling up the cavity of the adipose cells.

Fat, in chemistry. See Oil.

FATA *Morgana*, a very remarkable aerial phenomenon, which is sometimes observed from the harbour of Messina and adjacent places, at a certain height in the atmosphere. The name, which signifies the Fairy Morgana, is derived from an opinion of the superstitious Sicilians, that the whole spectacle is produced by fairies, or such-like visionary invisible beings. The populace are delighted whenever it appears; and run about the streets shouting

for joy, calling every body out to partake of the glorious sight.

This singular meteor has been described by various authors; but the first who mentioned it with any degree of precision was father Angelucci, whose account is thus quoted by Mr. Swinburne in his Tour through Sicily: "On the 15th of August, 1643, as I stood at my window, I was surprised with a most wonderful delectable vision. The sea that washes the Sicilian shore swelled up, and became, for ten miles in length, like a chain of dark mountains; while the waters near our Calabrian coast grew quite smooth, and in an instant appeared as one clear polished mirror, reclining against the ridge. On this glass was depicted in chiaro-scuro, a string of several thousand of pilasters, all equal in altitude, distance, and degree of light and shade. In a moment they lost half their height, and bent into arcades, like Roman aqueducts. A long cornice was next formed on the top, and above it rose castles innumerable, all perfectly alike. These soon split into towers, which were shortly after lost in colonnades, then windows, and at last ended in pines, cypresses, and other trees, even and similar. This is the Fata Morgana, which for twenty-six years I had thought a mere fable."

To produce this pleasing deception, many circumstances must concur, which are not known to exist in any other situation. The spectator must stand with his back to the east, in some elevated place behind the city, that he may command a view of the whole bay; beyond which the mountains of Messina rise like a wall, and darken the back ground of the picture. The winds must be hushed, the surface quite smooth, the tide at its height, and the waters pressed up by currents to a great elevation in the middle of the channel. All these events coinciding, as soon as the sun surmounts the eastern hills behind Reggio, and rises high enough to form an angle of 45 degrees on the water before the city, every object existing or moving at Reggio will be repeated a thousandfold upon this marine looking-glass; which, by its tremulous motion, is in a manner cut into facets. Each image will pass rapidly off in succession as the day advances, and the stream carries down the wave on which it appeared. Thus the parts of this moving picture will vanish in the twinkling of an eye. Sometimes the air is at that moment so impregnated with vapours, and undisturbed by winds, as to reflect objects in a kind of aerial screen, rising about 30 feet above the level of the sea. In cloudy heavy weather they are drawn on the surface of the water, bordered with fine prismatical colours.

FATHOM, a long measure containing six feet, chiefly used at sea for measuring the length of cables and cordage.

FEATHER, in physiology, a general name for the covering of birds: it being common to all the animals of this class to have their whole body, or at least the greatest part of it, covered with feathers or plumage.

Feathers make a considerable article of commerce, particularly those of the ostrich, heron, swan, peacock, goose, &c. for plumes, ornaments of the head, filling of beds, writing-pens, &c. Geese are plucked in some parts of Great Britain five times in the year; and in cold seasons many of them die by this barbarous custom. Those feathers that are brought from Somersetshire are esteemed the best, and those from Ireland the worst.

Eider down is imported from Denmark; the ducks that supply it being inhabitants of Hudson's-bay, Greenland, Iceland, and Norway. All the islands west of Scotland, breed numbers of these birds, which turn out a profitable branch of trade to the poor inhabitants. Hudson's-bay also furnishes very fine feathers, supposed to be of the goose kind. The down of the swan is brought from Dantzic. The best method of curing feathers is to lay them in a room, exposed to the air and sun; and when dried, to put them in bags, and beat them well with poles to get off the dirt.

Feathers, when chemically analysed, seem to possess very nearly the same properties with hair. According to Mr. Hatchett, the quill is composed chiefly of coagulated albumen, without any traces of gelatine.

FEATHER-*mill*, in the salt-works, the partition in the middle of the furnace, which it divides into two chambers.

FEATHER-*edged*, among carpenters, an appellation given to planks or boards which have one side thicker than the other.

FECES. The excrementitious matter of animals, evacuated per anum, consists of all that food which cannot be employed for purposes of nutrition, considerably altered, at least in part, and mixed or united with various bodies employed during digestion to separate the useless part of the food from the nutritious.

The constituents of human feces, according to the recent analysis of Berzelius, are the following:—

Water . . :	73.3
Vegetable and animal remains	7.0
Bile	0.9
Albumen	0.9
Peculiar extractive matter . .	2.7
Salts	1.2
Slimy matter, consisting of resin of bile, peculiar animal matter, and insoluble residue	14.0
	100.0

The salts were to one another in the following proportions:—

Carbonate of soda, ...	0.9
Muriate of soda, ...	0.1
Sulphate of soda, ...	0.05
Ammon. phos. magn. . . .	0.05
Phosphate of lime	0.1
	1.20

To MM. Fourcroy and Vauquelin we owe what precise knowledge we possess, regarding the excrements of birds, in which they found a large quantity of uric acid. This forms the white, and nearly crystaline portion. It does not proceed from the fœcal matter properly so called, but from the urine, which in this class of animals is mixed with the excrement, by the nature of their organization. This acid is easily extracted, by breaking the excrement with alkaline water, filtering the liquor, and pouring into it muriatic acid.

FEE, in law, *feudum*, *beneficium*, all land in England is in the nature of a feud or fee, and subject to the original conditions of the grant, which is supposed to come from the crown: but now that distinction is very immaterial.

FEE *simple*, is an estate of inheritance whereby a person is seised of lands, tenements, or hereditaments, to hold to him and his heirs for ever, generally, absolutely, and entirely; without mentioning what heirs, but referring that to his own pleasure, or the disposition of the law.

FEELERS, in natural history, a name used by some for the horns of insects. See ENTOMOLOGY.

FEELING, one of the five external senses, by which we obtain the ideas of solid, hard, soft, rough, hot, cold, wet, dry, and other tangible qualities.

This sense is the coarsest, but at the same time the surest of all others; it is besides the most universal. We see and hear with small portions of our body, but we feel with all. Nature has bestowed that general sensation wherever there are nerves, and they are every where, where there is life.

The object of feeling is every body that has consistency or solidity enough to move the surface of our skin. It was necessary to perfect feeling, that the nerves should form small eminences, because they are more easily moved by the impression of bodies, than a uniform surface.

FELAPTON, in logic, one of the six moods of the third figure of syllogisms, wherein the first proposition is a universal negative, the second an universal affirmative, and the third a particular negative.

FELIS, *cat*, in zoology, a genus of the mammalia class, belonging to the order of feræ. The generic character is: front teeth six, the intermediate ones equal; grinders three on each side; tongue aculeated backwards; claws retractile.

1. *Felis leo*, lion. The lion is principally an inhabitant of Africa, but is also found in the hotter regions of Asia. It is, however, in the interior of Africa that he exerts his greatest ravages, and reigns superior among the weaker quadrupeds. A lion of the largest size has been found to measure about eight feet from the nose to the tail, and the tail itself about four feet; the general colour is a pale tawny, still paler or more inclining to white beneath: the head is very large, the ears rounded, the face covered with short or close hair, the upper part of the head, the neck, and shoulders coated with long shaggy hair, forming a pendent mane; on the body the hair is short and smooth, the tail is terminated by a tuft of blackish hair. The lioness, which is smaller than the lion, is destitute of the mane, and is of a whiter cast beneath. The lion, like the tiger, frequently conceals himself in order to spring on his prey, bounding to the distance of a great many feet, and seizing it with his claws. His strength is prodigious: it has even been affirmed, that a single stroke of his paw is sufficient to break the back of a horse; and that he carries off with ease a middle sized buffalo. The roaring of the lion, when in quest of prey, resembles the sound of distant thunder; and, being re-echoed by the rocks and mountains, appals the whole race of animals, and puts them to sudden flight; but he frequently varies his voice into a hideous scream or yell: he is supposed to be destitute of a fine scent, and to hunt by the eye alone. The lion is commonly said to devour as much as will serve him for two or three days, and when satiated with food, to remain in a state of retirement in his den, which he seldom leaves, except for the purpose of prowling about for his prey.

The lioness is said to bring forth in the spring, in the most sequestered places, and to produce but one brood in the year.

2. *Felis tigris*, tiger, is a native of the warmer parts of Asia, and is principally found in India and the Indian islands. The species extends, however, as far as China and Chinese Tartary, the lake Ural, and the Altaic mountains. Its colour is a deep tawny, or orange-yellow, the face, throat, and under side of the belly, being nearly white; the whole is traversed by numerous long black stripes, forming a bold and striking contrast with the ground-colour. About the face and breast the stripes are proportionably smaller than on other parts; the tail is annulated with black, and is shorter than the body.

In its general size the tiger is inferior only to the lion, and has been seen even larger.

Of so fierce and sanguinary a disposition is the tiger, as to surpass in rapacity every other wild beast, and it is therefore considered as the most dreadful scourge of the hotter regions of Asia. His method of seizing his prey is by concealing himself from view, and springing with a horrible roar on his victim, which he carries off and tears in pieces, after having first sucked out the blood. The voice of the tiger, in the act of springing on his prey, is said to be hideous beyond conception. Even a buffalo has been thus seized by a tiger, and carried off with such seeming ease, as to appear scarcely an impediment to the animal's flight.

The tiger has been known to attack even a lion, and both animals have perished in the conflict. The tigress produces four or five young at a litter: she is at all times furious, but her rage rises to the utmost extremity when robbed of her young. She then braves every danger, and pursues her plunderers, who are often obliged to release one in order to retard her motion. She stops, takes it up, and carries it to the nearest cavern, but instantly returns and renews her pursuit, even to the very gates of buildings or the edge of the sea; and when her hope of recovering them is lost, she expresses her agony by hideous howlings, which excite terror wherever they reach.

3. *Felis pardus*, panther. Next to the tiger, the panther is the most conspicuous species in this genus, measuring about six feet and a half, and sometimes nearly seven feet from nose to tail, which is itself about three feet long. The colour of the panther is a beautiful tawny yellow, thickly marked with roundish black spots, and there is commonly a central spot in each circle. On the face and legs the spots are single, and along the top of the back is a row of oblong spots. The breast and belly are white; the former marked with transverse dusky stripes, the latter and the tail with large irregular black spots.

The panther is principally found in Africa, and is to that country what the tiger is to Asia, with this alleviating circumstance, that it is supposed to prefer the destruction of other animals to that of man. Its manner of seizing

its prey resembles that of the tiger, lurking near the sides of woods, &c. and darting forward with a sudden spring. It is of a highly ferocious nature, and scarcely to be tamed.

4. *Felis leopardus*, the leopard, is best distinguished from the panther by its paler yellow colour, its small size, and the somewhat closer disposition of the spots. The general length of this species from nose to tail, is four feet, of the tail two and a half. It is a native of Senegal and Guinea, as well as of many other parts of Africa; it also occurs in several parts of Asia, viz. in Persia, India, China, &c. In its manners it resembles the panther.

A variety of this species of a dusky black, marked with spots of a deeper or more glossy black, and perfectly resembling in disposition those of the common leopard, is found in Bengal.

5. *Felis jubata*, the hunting leopard, is about the size of a large greyhound, and of a long make, with narrow chest, and long legs. It is a native of India, where it is said to be tamed, and used for the chase of antelopes and other animals. If it happen to miss its prey, it returns immediately at the call of its master.

6. *Felis uncia*, the ounce, is scarcely inferior in size to the leopard. Its colour is dull white, with a slight yellowish or tawny cast, and the whole is scattered over with spots. In its general form the animal seems much allied to the leopard. It seems not to have been distinctly described by any modern author till the time of Buffon; but it is supposed to have been known to the ancients, and to have been the smaller panther of Oppian, and the panthera of Pliny. It is a native of several parts of Africa and Asia.

7. *Felis onca*, the Brazilian tiger, is a native of the hotter parts of South America, and is considered as a very fierce and destructive animal. Its manners are said to resemble those of the tiger, lying in ambush for its prey. It is about the size of a wolf, or even larger. Its ground-colour is a pale brownish-yellow, variegated on the upper parts with streaks and markings of black, the top of the back being marked with long interrupted stripes, and the sides with rows of regular open marks.

8. *Felis pardalis*, ocelot. The ocelot or pardalis is certainly one of the most beautiful of the present genus. Mr. Pennant describes it as about four times the size of a large cat. The ground-colour of the male is a bright reddish-tawny above, nearly white on the lower part. Several large stripes, of a deeper or richer tinge than the ground-colour, are disposed over the upper parts of the body: these stripes are edged with black, and have also several differently shaped black spots in the middle part. The head is streaked and spotted with black, and the upper as well as under parts of the limbs and the belly marked in a beautiful manner with small and numerous round spots; the tail is patched or spotted also. The colours of the female are less vivid, and more inclining to ash-colour. This is an extremely ferocious animal, and inhabits the hotter parts of South America.

9. *Felis puma*. The puma is the largest of the American beasts of prey, measuring five feet or more from nose to tail, the tail itself about two feet eight inches. It is a long-bodied animal, and stands high on its legs. Its colour is a pale brownish-red, with a slight dusky cast on some parts; the chin is white; the breast and belly ash-coloured; and the insides of the legs are of the same colour; the tail of a dusky-ferruginous tinge, with a black tip. It is a native of many parts of America both north and south, occurring from Canada to Brazil.

10. *Felis discolor*, black tiger. This, like the former species, is a native of America, and is considered as a very destructive animal. It is about the size of a large dog, and is entirely of a brownish-black colour on the upper parts, and pale-grey or whitish beneath.

11. *Felis tigrina*, margay. The margay is a native of South America, and is about the size of a common cat. The ground-colour is a bright tawny; the face striped with black; the shoulders and body marked both with stripes and large black spots; the tail is long, and marked with black and grey. It resides principally on trees, preying on birds: it is said to breed in the hollows of trees, and is very fierce and untameable.

12. *Felis capensis*, the Cape cat, inhabits the neighbourhood of the Cape of Good Hope. In its manners it seems to resemble the common cat, frequenting trees, and preying on smaller animals.

13. *Felis manul*. This species inhabits the middle part of northern Asia. It is of the size of a fox, and is of a strong and robust make. Its colour is tawny, the tail is longer than that of a domestic cat, and is thickly beset with hair, and encircled with ten black rings.

14. *Felis catus*. The cat, in a state of natural wildness, and from which are supposed to have proceeded all the varieties of the domestic cat, is a native of the northern regions of Europe and Asia. In its natural state it differs in some slight particulars from the domestic animal, having a shorter tail in proportion, a flatter and larger head, and stronger limbs. The colour is commonly a pale yellowish-grey, with dusky stripes and variegations, those on the back-running lengthwise, those on the sides transversely and with a curved direction: the tail is annulated with alternate circles of blackish-brown and dull white; the tip of the nose and the lips are black. Even wild cats, however, appear to differ in their shades of colour in different parts of Europe.

The manners of the wild cat resemble those of the lynx, and several others of this genus, living in woods, and preying on young hares, on birds, and a variety of other animals, which it seizes by surprise. It breeds in the hollows of trees, and produces about four at a birth. Of all the above varieties, the Persian and the Angora are the most remarkable: the latter variety has one eye blue, the other yellow; a particularity which takes place in some specimens of the common white cat. It is also observable, that the white variety of the cat is sometimes perfectly deaf.

No animal exhibits a greater degree of maternal tenderness than the cat. She even possesses a propensity to nurse with tenderness the young of a different individual; and will

commonly suckle and nurse any young kitten that is newly introduced to her.

The fur of the cat, being generally clean and dry, readily yields electric sparks when rubbed; and if a clean and perfectly dry domestic cat is placed, in frosty weather, on an insulated stool, and rubbed for a certain space in contact with the wire of a coated phial, it will be effectually charged by this method.

15. *Felis serval.* The serval is a native of India and Tibet, and is an extremely fierce and rapacious animal. It resides principally among trees, leaping with great agility from one tree to another, and pursuing birds, &c. Its shape is thick and strong; its general colour is fox-red or ferruginous, with the throat, abdomen, and insides of the legs, yellowish-white.

16. *Felis chaus,* is an inhabitant of the marshy tracts on the western side of the Caspian Sea, and in the Persian provinces of Ghilan and Masenderen. In manners, it agrees with the wild cat. Its general length is about two feet six inches from the nose to the tail. The colour of this species is a dusky yellowish-brown; the tail is tipped with black, and the ears are tufted with black hairs.

.7. *Felis rufa,* bay lynx. This species is about twice the size of a large cat, and is a native of North America. Its colour is a bright bay, obscurely marked with small dusky spots. The hair is shorter and smoother than that of the common lynx.

18. *Felis caracal,* the caracal or Persian lynx, is a native both of Asia and Africa; in some parts of Persia it is tamed and made use of in the chase. It is an animal of great strength and fierceness. It is used not only in the chase of the smaller quadrupeds, but of the larger kinds of birds, such as herons, cranes, pelicans, &c. The caracal is about the size of a fox, but of a much stronger make its colour is a pale reddish-brown, whitish beneath.

19. *Felis lynx,* the common lynx, is found in all the colder regions of Europe, Asia, and America, residing in thick woods, and preying on hares, deer, birds, and other animals. The general size of the lynx is that of a middling dog. In colour the lynx varies, but is generally of a pale-grey, with a very slight reddish tinge; the back and whole upper parts are obscurely spotted with blackish marks. The throat, breast, and belly, are white; the tail white, with a black tip; the ears tipped with pencils of long black hair.

FELLOES, in fortification, are six pieces of wood, which, with the addition of a nave and twelve spokes, make the wheel of a gun-carriage.

FELLOWSHIP, or COMPANY, in arithmetic, is when two or more join their stocks, [illegible] rther, dividing their gain or loss [illegible]

Fellowship is either with or without time. Questions without time, or the single rule of fellowship, as it is frequently called, are wrought by the following proportion:

As the whole stock, to the whole gain or loss, so is each man's particular stock, to his particular gain or loss.

FELLOWSHIP *with time,* usually called the *double rule of fellowship,* because every man's money is to be considered with relation to the time of its continuance in the joint stock. It is worked thus: multiply each man's stock by the respective time he puts it in for, and add all the products; the total of which must be the first number through all the statings; the gain or loss the second, as before; and each man's particular stock, multiplied by its time, the third.

FELO *de se,* in law, one who is felon of himself; i.e. being of sound memory, and of the age of discretion, or 14 years, kills himself. All his chattels, real and personal, are forfeited to the crown, when it is found by the Coroner that he is *felo de se.* A will, therefore, made by him, is void as to his personal estate, but not as to his land or real estate; nor is his wife barred of her dower. If a man and his wife are possessed of a term, and the man commit suicide, the term is forfeited, and the wife shall not have it by survivorship. The coroner must find the fact upon an inquest, on view of the body, in order to vest the goods in the king.

FELONY, in the general acceptation of law, comprises every species of crime which occasioned at common law the forfeiture of lands or goods. This generally happens in those for which a capital punishment either was or is liable to be inflicted; for those felonies to which the benefit of clergy extends, were anciently punished with death in lay or unlearned offenders; though now, by the statute law, that punishment is for the first offence universally remitted.

FELSPAR, one of the essential component parts of granite, and is itself a compound substance; silica and alumina being the chief ingredients. It generally contains a little lime and pot-ash, and is often coloured with minute portions of oxide of iron. It is softer than quartz, but harder than glass, and is fusible by the blow-pipe. For the different species of this substance. See MINERALOGY.

FELT, in commerce, a sort of stuff, deriving all its consistence merely from being fulled or wrought with lees and size, without either spinning or weaving. Felt is made either of wool alone, or of wool and hair.

FELTING. See HATMAKING.

FELUCCA, in sea affairs, a little vessel with six oars, frequent in the Mediterranean, which has this peculiarity, that its helm may be applied either in the head or stern as occasion requires.

FEME *covert,* a married woman, so called from being under the cover, protection, and influence of her husband.

FEME *sole,* a single or unmarried woman A feme sole is liable to perform parish offices, the act only requiring the person to be a substantial householder, without reference to sex.

FEMINEUS *flos,* a female flower. By this name Linnæus denominates a flower which is furnished with the pistillum, or female organ of generation, but wants the stamina or male organ. Female flowers may be produced apart from the male, either on the same root or on distinct plants. The birch and mulberry are examples of the first case; willow and poplar of the second.

FEN, a place overflowed with water, or abounding with bogs.

Fens are either made up of a congeries of bogs, or consist of a multitude of pools or lakes with dry spots of land intermixed, like so many little islands.

FENCE, in country affairs, a hedge, wall, ditch, bank, or other inclosure, made around gardens, woods, corn-fields, &c.

FENCING, the art of making a proper use of the sword, as well for attacking an enemy, as for defending one's self. It is necessary in acquiring this difficult art to use foils, or small thin swords, which being blunted at the points, and bending readily, prevents accidental wounds.

FEOD or **Feud**, is the right which a vassal had in lands or other property belonging to his Lord, to use them, and appropriate the profits thereof hereditarily, rendering to the lord such duties and services as belong to the military tenure; the property of the soil, &c. always remaining to the lord. From this arose the feudal system, which about twelve centuries ago was universally received in Europe.

FEOFFMENT, in law, may be defined to be the gift of any corporeal hereditament to another. He that so gives or enfeoffs is called the feoffer; and the person enfeoffed is denominated the feoffee.

FERÆ, in zoology, an order of quadrupeds, the distinguishing characters of which are, that all the animals belonging to it have fore-teeth conic, usually six in each jaw; tusks longer; grinders with conical projections; feet with claws; claws subulate; food, carcases, and preying on other animals.

Feræ *naturæ*. Animals of a wild nature are those in which a man has not an absolute but only a qualified and limited property, which sometimes subsists, and at other times does not subsist.

FERMENTATION. When aqueous combinations of vegetable or animal matter are exposed to ordinary atmospherical temperatures, they speedily undergo spontaneous changes, to which the generic name of *fermentation* has been given. Animal liquids alone, or mixed with vegetables, speedily become sour. The act which occasions this alteration is called acetous fermentation, because the product is, generally speaking, acetic acid, or vinegar. But when a moderately strong solution of saccharine matter, or saccharine matter and starch, or sweet juices of fruits, suffer this intestine change, the result is an intoxicating liquid, a beer, or wine; whence the process is called vinous fermentation. An ulterior change to which all moist animal and vegetable matter is liable, accompanied by the disengagement of a vast quantity of fetid gases, is called the putrefactive fermentation.

Each of these processes goes on most rapidly at a somewhat elevated temperature, such as 80° or 100° F. It is for these reasons that, in tropical countries, animal and vegetable substances are so speedily decomposed.

As the ultimate constituents of vegetable matter are oxygen, hydrogen, and carbon; and of animal matter, the same three principles with azote, we can readily understand that all the products of fermentation must be merely new compounds of these three or four ultimate constituents.

All vegetable substances containing saccharine matter are susceptible of the vinous fermentation. During the process of fermentation, the liquor first becomes turbid and viscid; an intestine motion and an increase of bulk take place: air bubbles are discharged from the whole mass, bursting forth with a hissing noise, and forming a beautiful froth on the surface. The sweetness of the liquor disappears, and it acquires a pungent taste. After a certain time these appearances cease; a sediment is deposited, and the liquor becomes perfectly clear. It is now found to have acquired a brisk taste, a vinous flavour, and an intoxicating quality.

When it is required to preserve fermented liquors in the state produced by the first stage of fermentation, it is usual to put them into casks before the vinous process is completely ended; and in these closed vessels a change very slowly continues to be made for many months, and perhaps for some years.

But if the fermentative process be suffered to proceed in open vessels, more especially if the temperature be raised to 90 degrees, the acetous fermentation comes on. In this, the oxygen of the atmosphere is absorded; and the more speedily in proportion as the surfaces of the liquor are often changed by lading it from one vessel to another. The usual method consists in exposing the fermented liquor to the air in open casks, the bung-hole of which is covered with a tile to prevent the entrance of the rain. By the absorption of oxygen which takes place, the inflammable spirit becomes converted into an acid. If the liquid be then exposed to distillation, pure vinegar comes over instead of ardent spirit.

When the spontaneous decomposition is suffered to proceed beyond the acetous process, the vinegar becomes viscid and foul; air is emitted with an offensive smell; volatile alkali flies off; an earthy sediment is deposited; and the remaining liquid, if any, is mere water. This is the putrefactive process.

The fermentation by which certain colouring matters are separated from vegetables, as in the preparation of woad and indigo, is carried much farther, approaching the putrefactive stage.

It is not clearly ascertained what the yeast or ferment performs in this operation. It seems probable, that the fermentative process in considerable masses would be carried on progressively from the surface downwards; and would, perhaps, be completed in one part before it had perfectly commenced in another, if the yeast, which is already in a state of fermentation, did not cause the process to begin in every part at once.

FERRARIA, a genus of the triandria order, in the gynandria class of plants, and in the natural method ranking under the sixth order ensatæ. There are two species, natives of the Cape of Good Hope and Mexico.

FERRUGINOUS, any thing partaking of iron, or that contains particles of that metal. It is particularly applied to certain mineral springs, whose waters are impregnated with the particles of iron generally termed chalybeats.

FERULA, *fennel giant*, a genus of the digynia order, in the pentandria class of plants, and in the natural method ranking under the 45th order, umbellatæ. There are nine species, all of them herbaceous perennials, rising from three to ten or twelve feet high, with yellow flowers.

FEVER, *febris*, in medicine, a disease, or rather class of diseases, whose characteristic is a preternatural heat felt through the whole body, or at least the principal parts of it.

FIBRE, in anatomy, a perfectly simple body, or at least as simple as any thing in the human structure, being fine and slender like a thread, and serving to form other parts. Hence some fibres are hard, as the bony ones; and others soft, as those destined for the formation of all the other parts.

FIBRINA, is that substance which constitutes the fibrous part of the muscles of animals. If a quantity of blood, newly drawn from an animal, be allowed to remain at rest for some time, a thick red clot gradually forms in it, and subsides. Separate this clot from the rest of the blood, put it into a linen cloth, and wash it repeatedly in water till it ceases to give out any colour or taste to the liquid; the substance which remains after this process, is denominated fibrina. Fibrina is of a white colour, has no taste nor smell, and is not soluble in water nor in alcohol.

FIBROLITE. Colours white and grey; crystallized in rhomboidal prisms, the angles of whose planes are 80° and 100°. It is glistening internally. Principal fracture uneven. Harder than quartz. Sp. gr. 3.214. Its constituents are alumina 58.25, silica 38, iron and loss 3.75. It is found in the Carnatic.

FICUS, a genus of the triœcia order, in the polygamia class of plants, and in the natural method ranking under the 53d order, scabridæ. There are 56 species, of which the following are the most remarkable.

1. *Ficus indica*, or banian-tree, is a native of several parts of the East Indies. It has a woody stem, branching to a great height and vast extent, with heart-shaped entire leaves ending in acute points.

The banian tree, or Indian fig, is perhaps the most beautiful of nature's productions in that genial climate. Some of these trees are of amazing size and great extent, as they are continually increasing, and, contrary to most other things in animal and vegetable life, seem to be exempted from decay. Every branch from the main body throws out its own roots; at first, in small tender fibres, several yards from the ground: these continually grow thicker until they reach the surface; and there striking in, they increase to large trunks, and become parent trees, shooting out new branches from the top: these in time suspend their roots, which, swelling into trunks, produce other branches; thus continuing in a state of progression as long as the earth contributes its sustenance.

Near these trees the most esteemed pagodas are generally erected; under their shade the Brahmins spend their lives in religious solitude; and the natives of all casts and tribes are fond of recreating in the cool recesses, beautiful walks, and lovely vistas of this umbrageous canopy, impervious to the hottest beams of a tropical sun.

2. The *sycamorus*, or sycamore of scripture. According to Hasselquist, this is a huge tree, the stem being often 50 feet round. The fruit is pierced in a remarkable manner by an insect. The place affected becomes black; the fleshy substance in the middle of the calyx, for the breadth of a quill, is corroded · and the male blossoms, which are nearest to the bare side, appear naked, opening a way for the insect, which makes several furrows in the inside of the fruit, but never touches the stigmata, though it frequently eats the germen.

3. The *carica*, or common fig, with an upright stem branching 15 or 20 feet high, with large palmated or hand-shaped leaves. Of this there are a number of varieties.

FIDDLE. See Violin.

FIELD, in heraldry, is the whole surface of the shield. It is the ground on which the colours, bearings, metal, furs, charges, &c. are represented.

Field-*book*, in surveying, that in which the angles, stations, distances, &c. are set down. See Surveying.

Field-*pieces*, small cannon, from three to twelve pounders, carried along with an army in the field.

Field-*works*, in fortification, are those thrown up by an army in besieging a fortress, or by the besieged to defend the place. Such are the fortifications of camps, highways, &c.

FIFE, a shrill wind-instrument of the martial kind, consisting of a short narrow tube, with holes disposed along the side, for the regulation of its tones.

FIFTEENTH, an ancient tribute or tax laid upon cities, boroughs, &c. throughout all England, and so termed because it amounted to a fifteenth part of what each city or town had been valued at: or it was a fifteenth of every man's personal estate according to a reasonable valuation. In Doomsday-book, there are certain rates mentioned for levying this tribute yearly. The present property-tax seems a revival of this ancient system.

Fifteenth, an interval consisting of two octaves.

FIFTH, in music, a distance comprising four diatonic intervals, *i. e.* three tones and a half.

Fifth, *sharp*. The sharp fifth is an interval consisting of eight semitones.

FIG. See Ficus.

FIGURATE *numbers*, such as do or may represent some geometrical figure, in relation to which they are always considered; as triangular, pentagonal, pyramidal, &c. numbers.

FIGURE, in conic sections, according to Apollonius, is the rectangle made under the latus rectum and transversum in the hyperbola and ellipsis.

Figure, in fortification, the plan of any fortified place, or the interior polygon, which, when the sides and angles are equal, is called a regular, and when unequal, an irregular figure.

Figure, in geometry, the superficies included between one or more lines, is denominated either rectilinear, curvilinear, or mixed, according as the extremities are bounded by right lines, curve lines, or both.

Figure, in grammar, a deviation from the natural rules of etymology, syntax, and prosody, either for brevity, elegance, or harmony.

Figure, in logic, denotes a certain order and disposition of the middle term in any syllogism.

Figure, in painting and designing, denotes the lines and colours which form the representation of any animal, but more particularly of a human personage.

Figure, in rhetoric, is a manner of speaking different from the ordinary and plain way, and more emphatical; expressing a passion, or containing a beauty. See Rhetoric.

FILACER, or *filizer*, an officer of the Court of Common Pleas, so called because he files those writs whereon he makes out process.

FILAGO, a genus of the polygamia necessaria order, in the syngenesia class of plants, and in the natural method ranking under the 49th order, compositæ. There are seven species, commonly known by the name of cudweed, natives of most parts of Europe, herbaceous, most of them annual.

FILAMENTS, vegetable, form a substance of great use in the arts and manufactures, furnishing thread, cloth, cordage, &c. For these purposes the filamentous parts of hemp and flax are employed among us. Different vegetables have been employed in different countries for the same uses. In some parts of Sweden a strong cloth is said to have been prepared from the stalks of hops. These have been tried here, but without success. Vegetable filaments, and the thread or cloth prepared from them, differ remarkably from wool, hair, silk, and other animal productions, particularly in their disposition to imbibe colouring matters; sundry liquors, which give a beautiful and durable dye to those of the animal, giving no stain at all to those of the vegetable kingdom.

FILARIA, a genus of insects of the order intestina. There are several species, some infesting different animals and insects. The medinensis is the most remarkable species; it inhabits the Indies, and is frequent in the morning dew, whence it enters the naked feet of the slaves, and creates the most troublesome itchings, accompanied with inflammation and fever.

FILBERT. See Corylus.

FILE, among mechanics a tool used metal, &c. in order to smooth, polish, or cut.

This instrument is of iron, or forged steel, cut in little furrows, with chisels, and a mallet, in a certain direction, and of a certain depth, according to the grain or touch required. Files are cut by the hand, although several engines have been invented for the purpose. Engines, however much they may facilitate the process, do not answer, as appears from the circumstance of their not being used in any file manufactory. This is satisfactorily accounted for by Mr. Nicholson, who some years ago obtained a patent for an improvement of this kind. He says:—

The principal requisites in a machine for file-cutting are, that the file should be steadily supported, and the chizel adapted to the face without any unequal bearing. Files are however, for the most part, cut by hand; and the chief reasons are, 1. The cut by hand is, from its very nature, exactly of the depth the bur demands; whereas, in a machine, if the stroke be not nicely adapted to the shift, the file may be either shallow-cut, or its bar may be thrown too close by an over heavy stroke; and, 2. In machine cut files, there must always be a piece left at the beginning, at each corner, which requires to be cut off before hardening. This may be remedied in the machinery, but it has not yet been done.

FILIGRANE *work*, or filagree work, from *filum* and *granum*, is the name given to a kind of ornamental work, in which flowers, &c. are formed of fine gold and silver wire curled or twisted in a serpentine form, and sometimes plaited, and worked through each other, and soldered together. This art appears to have been brought from the East, and has been occasionally employed in all ages.

FILIX, an order of the cryptogamia class of plants, comprehending the fern, horse-tail, adder's-tongue, maiden-hair, spleen-wort, polypody, &c.

FILLET, in heraldry, a kind of bordure, containing only a third or fourth part of the breadth of the common bordure. It is supposed to be withdrawn inwards, and is of a different colour from the field.

FILTER, or *filtre*, in chemistry, a strainer commonly made of bibulous or filtering paper in the form of a funnel, through which any fluid is passed, in order to separate the gross particles from it, and render it limpid.

FILTERING paper, is paper without size. To use it as such, the paper is shaped into the form of a cone, and placed in a funnel, in order to support it; otherwise it would break.

Filtering stones, basons, &c. are either natural or artificial, for the purpose of purifying water.

The common filtering stones are liable to several objections, such as their pores becoming closed up by the sediment which is deposited by the impure water, the inequality of the pressure, &c. Various filtering machines have been invented by different persons; but the simplest we have ever seen described, and which, on account of its cheapness, falls within the reach of every family, is one invented by Mr. Lewis of London, and by him described in the Mechanics Magazine. "It consists of a large earthen flower-pot, through the bottom of which is fixed a leaden pipe, of sufficient length to reach within six inches of the top of the pot. The bottom of the pot, (inside) is then covered with fine clean sand, about two inches deep; above this is another layer of coarser sand, mixed with charcoal dust, about two inches deep; and over all there is a layer of coarse sand, or gravel. Another pot, much smaller than the first, is then inverted over the pipe, inside the large pot, and pressed down through the sand, till it nearly touches the bottom: the machine is now complete

The water is poured into the sand and gravel around the exterior of the inverted pot. It filters to the bottom, then finds its way up the inside of the smaller pot, till it reaches the top of the leaden pipe, down which it immediately runs into any vessel put to receive it. As this filtering machine acts on the principle of a syphon, the water is drawn through much quicker than when it falls merely by its own weight.

This simple filtering machine will be found highly beneficial to those who value the luxury of pure soft water during the heat of summer. The editor has tried the experiment; and with one, on rather a small scale, but carefully constructed, he obtained the following result.

From a wooden rain-water cistern a quantity of water was taken, teeming with animalcula, and having a very offensive smell. It was then poured gently on the gravel in the machine, and began, in the course of ten minutes, to run from the pipe, at the rate of a pint in four minutes, having the appearance of the finest spring water, and so completely freed from every thing offensive, that on being presented at table it was pronounced to be excellent.

It is recommended to place a layer of fine pebbles over the surface of the gravel to prevent its being disturbed by the pouring on of the water.

FIN, in natural history, a well-known part of fishes, consisting of a membrane supported by rays, or little bony or cartilaginous ossicles.

FINANCE, the œconomy of the public revenue and expenditure of nations.

The English system of finance rests on the produce of the various taxes which have been imposed at different periods, the aggregate amount of which, after deducting the expences of collection, together with a few small articles which cannot properly be called taxes, forms the whole of the public income. This income is annually appropriated to the several branches of the national expenditure, and when in consequence of any extraordinary expences it is known that the income of the current year will be insufficient to meet all the demands upon it, it is usual to borrow the sum necessary to make up the deficiency, either from individuals or public bodies, and to allow a fixed rate of interest on the money thus obtained, till the principal shall be repaid, or till the period originally agreed upon shall have expired.

FINE, in law, hath different significations. It sometimes denotes a formal conveyance of lands or tenements or of any inheritable thing in order to cut off all controversies: sometimes it means a sum of money paid for entering into the possession of lands or tenements let by lease. Again it signifies a pecuniary mulct for an offence committed against the king or the lord of the manor.

FINERS of gold and silver, are those who separate those metals from coarser ores.

FINERY, in the iron-works, one of the forges at which the iron is hammered and fashioned into what they call a bloom, or square bar.

FIRE. See CALORIC and COMBUSTION.

FIRE, *balls of*, in meteorology, a kind of luminous bodies, generally appearing at a great height above the earth, with a splendour surpassing that of the moon; and sometimes equalling her apparent size. They generally proceed in this hemisphere from north to south with vast velocity, frequently breaking into several smaller ones, sometimes vanishing with a report, sometimes not.

FIRE-*ball*, in the art of war, a composition of meal-powder, sulphur, saltpetre, pitch, &c. about the size of a hand-grenade, coated over with flax, and primed with a slow composition of a fuse. This is to be thrown into the enemy's works in the night time, to discover where they are: or to fire houses, galleries, or blinds of the besiegers; but the use of these is now superseded by the still more certainly destructive invention of the Congreve Rocket.

FIRE-*ships*, in the navy, are vessels charged with combustible materials or artificial fireworks; which having the wind of an enemy's ship, grapple her, and set her on fire.

FIRE *flies*, a species of flies common in Guiana, of which there are two species. The largest is more than an inch in length, having a very large head connected with the body by a joint of a particular structure, with which sometimes it makes a loud knock, particularly when laid on its back. The fly has two feelers or horns, two wings, and six legs. Under its belly is a circular patch, which, in the dark, shines like a candle; and on each side of the head near the eyes is a prominent, globular, luminous body, in size about one-third larger than a mustard-seed. Each of these bodies is like a living star, emitting a bright, and not small, light; since two or three of these animals, put into a glass vessel, afford a light sufficient to read without difficulty, if placed close to the book. When the fly is dead, these bodies will still afford considerable light, though it is less vivid than before; and if bruised, and rubbed over the hands or face, they become luminous in the dark, like a board smeared over with English phosphorus. They are of a reddish-brown or chesnut colour: and live in rotten trees in the day, but are always abroad in the night. The other kind is not more than half as large as the former: their light proceeds from under their wings, and is seen only when they are elevated, like sparks of fire appearing or disappearing at every second.

FIRE *engine.* See HYDROSTATICS.

FIRKIN, an English measure of capacity, for things liquid, being the fourth part of the barrel: it contains nine gallons of beer.

FIRLOT, a dry measure used in Scotland. The oat-firlot contains 21¼ pints of that country; the wheat-firlot contains about 2,211 cubical inches; and the barley-firlot, 31 standard pints.

FIRST *fruits* and *tenths*, in law. First fruits are the profits of every spiritual living for one year: and tenths are the tenth of the yearly value of such living, given anciently to the Pope throughout all Christendom; but by stat. 26 Hen. VIII. c. 3. transferred to the King of England. By stat. 27 Hen VIII. c. 3. no tenths are to be paid for the first year, as then the first fruits are due; and by several statutes in the reign of Queen Anne, benefices under 50*l.* per annum shall be discharged of the payment of first fruits and tenths. She also restored the profits of this revenue to the church, by establishing a perpetual fund therefrom, vested in trustees for the augmentation of poor livings under 50*l.* a year. This is called Queen Anne's bounty, and is further regulated by subsequent statutes; but as the number of livings under 50*l.* was at the commencement of it 5,597, averaged at 23*l.* per annum, its operation will be very slow

FISCAL, in the civil law, something relating to the pecuniary interest of the prince or people.

FISH. See PISCES.

FISHERY, a place where great numbers of fish are caught.

The principal fisheries for salmon, herring,

mackrel, pilchards, &c. are along the coasts of England, Scotland and Ireland; for cod, on the banks of Newfoundland; for whales, about Greenland; and for pearls, in the East and West Indies.

Free fishery, in law, or an exclusive right of fishing in a public river, is a royal franchise; and differs from a several of piscary, because he that has a several fishery must also be the owner of the soil, which in a free fishery is not requisite. It differs also from the common fishery, in that the free fishery is an exclusive right, the common is not so; and therefore, in a free fishery, a man has a property in the fish before they are caught; in a common pisca[illegible] not till afterwards.

FISTULA, in surgery, a deep, narrow and callous ulcer, generally arising from abscesses.

FISTULARIA, *pipe fish*, a genus of the order abdominales. The species are:

1. *Fistularia tabacaria*, or slender fistularia. This grows to the length of three or four feet, and is of the shape of an eel, the head about nine inches long; the eyes are large and ovate, with a blue pupil and silvery iris, marked on the fore and hind part by a red spot; the skin smooth and of a liver-colour marked by blue spots, with greenish ones intermixed. The appearance of the tail is singular, being deeply forked, while from the middle of the furcature springs a long bristle process, resembling whalebone, and tapering to a point. A variety has been observed by Dr. Bloch, in which this part was double, and the snout serrated on each side.

This species lives chiefly on the smaller fishes, sea-insects, and worms.

2. *Fistularia Chinensis*, or *Chinese Fistularia*, in its general shape resembles an eel, but the body is thicker in proportion than in the preceding species: It is a native of the Indian seas, preying on worms, sea-insects, &c.

3. *Fistularia paradoxa*, paradoxical fistularia, is a small species, from two to four inches in length. It is a native of the Indian seas.

FITCHEE, in heraldry, a term applied to a cross, when the lower end of it is sharpened into a point.

FIXED *stars*. See Astronomy.

FLACOURTIA, a genus of the class and order dioecia polyandria. There is one species, a small tree of Madagascar, bearing an eatable fruit in some degree resembling a plum.

FLAG, a general name for colours, standards, ancients, banners, ensigns, &c. which are frequently confounded with each other.

The fashion of pointed, or triangular flags, as now used, came from the Mahometan Arabs, or Saracens, upon their seizing of Spain, before which time all the ensigns of war were stretched, or extended on cross pieces of wood, like the banners of a church. The pirates of Algiers, and throughout the coasts of Barbary, bear an hexagonal flag.

Flag, is more particularly used at sea, for the colours, antients, standards, &c. borne on the top of the masts of vessels, to notify the person who commands the ship, of what nation it is, and whether it is equipped for war or trade.

The admiral in chief carries his flag on the mai[illegible]p; and the vice-admiral on the fore-top; and the rear-admiral on the mizen top.

FLAGELLARIA a genus of the hexandria monogynia class and order of plants. There are two species, shrubs of the East Indies.

FLAGEOLET, or *flajeolet*, a little flute, used chiefly by shepherds, and country people. It is made of box, or any other hard wood, and sometimes of ivory; and has six holes besides that at the bottom, the mouth-piece, and that behind the neck.

FLAIL, an instrument for thrashing corn. See Husbandry.

A flail consists of the following parts: 1. The hand-staff, or piece held in the thrasher's hand 2. The swiple, or that part which strikes out the corn. 3. The caplins, or strong double leathers, made fast to the tops of the hand-staff and swiple. 4. The middle-band, being the leather-thong, or fish-skin, that ties the caplins together.

FLAME. The following is the description given of flame by Mr. Gurney, in his Lectures on Chemical Science.

"The *flame* proceeding from a burning body is hollow within; that is, it contains within it no matter in actual combustion; and it assumes the conical form, which it usually bears, in consequence of the pressure of the external air on the outward side of it.

The flame, as it is called, consists of a thin *film* or *coat* of matter in a state of actual combustion, and this film is the only portion of the burning body which can properly be said to be in that state. I conceive that it assumes this appearance at the precise instant the combustible body and the supporter of combustion enter into combination with each other. Immediately on taking this form it passes off from the quantity of combustible matter which exists within it; and which matter itself proceeds immediately from the main body which is supplying the whole; so that an object in a state of flame, seems to consist of matter under three several states or forms: first, the main body of the object which is gradually passing from a low to a high temperature; secondly, that portion of the object in question which has already reached that high temperature, but has not yet passed into a state of flame, because it is confined within the external film of flame, and is therefore not capable of coming into contact with the atmosphere that is to supply it with oxygen or support; and lastly, that portion which is in a state of actual flame, and is passing off from time to time, thus permitting another portion of that contained within it to assume a similar form.

FLAMINGO, in ornithology. See Phœnicopterus.

FLANKS *of an army*, are the troops encamped on the right and left, as the flanks of a battalion are the files on the right and left.

Flanks *of a bastion*, in fortification, that part which joins the face to the curtain. See Fortification.

FLANNEL, a kind of slight, loose, woollen stuff, composed of a woof and warp, and woven on a loom with two treadles, after the manner of baize. Dr. Black assigns as a reason why flannel and other substances of the kind keep our bodies warm, that they compose a rare and spongy mass, the fibres of which touch each other so slightly, that the heat moves slowly through the interstices, which being filled only with air, and that in a stagnant state, gives little assistance in conducting the heat.

FLAT, in the sea-language. To flat in the fore-sail, to hale it in by the sheet, as near the ship's side as possible: which is done when a ship will not fall off from the wind.

Flat, in music, a character which being placed before a note, signifies that the note is to be sung or played half a tone lower than its natural pitch.

FLATULENCY. See Medicine.

FLAX. See Linum.

FLEA. See Pulex.

FLEECE, the covering of wool, shorn off the bodies of sheep. See Wool.

FLEECY-*hosiery*, a useful kind of manufacture, in which fine fleeces of wool are interwoven into a cotton piece of the common stocking texture.

FLEET, commonly implies a company of ships of war, belonging to any prince or state; but sometimes it denotes any number of trading-ships, employed in a particular branch of commerce.

Fleet, a prison in London, to which persons are committed for contempt of the king and his laws, particularly of his courts of justice: or for debt, where any person will not, or is unable to pay his creditors. There are large rules, and a warden belonging to the Fleet prison, which had its name from the float or fleet of the river or ditch on the side whereof it stands.

FLESH, in anatomy, a fibrous part of an animal body, soft and bloody, being that of which most of the other parts are composed, and by which they are connected together: or, more properly, it is that part of the body where the blood-vessels are so small, as only to retain blood enough to preserve their colour red.

FLEXOR. See Anatomy.

FLEXURE *of curves*, in the higher geometry, is used to signify that a curve is both concave and convex, with respect to a given right line.

FLINT, a semi transparent and hard stone, well known for its valuable property of giving fire when struck with steel. The colour is generally grey, with occasionally zoned and striped delineations. It occurs often in extraneous shapes, as echinites, coralites, madreporites, fungites, belemnites, mytilites, &c.; sometimes in lamellar concretions. Internal lustre glimmering. Fracture conchoidal. Fragments sharp-edged. Translucent. Harder than quartz. Easily frangible. Specific gravity 2.59. Infusible without addition, but whitens and becomes opaque. Its constituents are 98 silica. 0.50 lime, 0.25 alumina, 0.25 oxide of iron, 1 0 loss. When two pieces of flint are rubbed together in the dark, they phosphoresce, and emit a peculiar smell.

It occurs in primitive transition, secondary and alluvial mountains. In the first two, in metalliferous and agate veins. In secondary countries it is found in pudding-stone, limestone, chalk, and amygdaloid. In chalk it occurs in great abundance in beds. These seem to have been both formed at the same time. Werner, however, is of opinion, that the tube rose and many other forms, have been produced by infiltration. In Scotland, it occurs imbedded in secondary limestone in the island of Mull, and near Kirkaldy in Fifeshire. In England, it abounds in alluvial districts in the form of gravel, or is imbedded in chalk. In Ireland it occurs in considerable quantities in secondary limestone. It is found in most parts of the world

The manufacture of gun-flints is chiefly confined to England, and two or three departments of France. The operation is exceedingly simple, and a good workman will make 1000 flints a day. The whole art consists in striking the stone repeatedly with a kind of mallet, and bringing off at each stroke a splinter, sharp at one end, and thicker at the other. The splinters are afterwards shaped at pleasure, by laying the line at which it is wished they should break, upon a sharp instrument, and then giving [illegible] small blows with a mallet.

FLOAT *of a fishing line*, the cork or quill that floats or swims above the water.

Float also signifies a certain quantity of timber bound together with rafters athwart, and put into a river to be conveyed down the stream; and even sometimes to carry burdens down a river with the stream.

Float-*boards*, those boards fixed to water-wheels of undershot mills, serving to receive the impulse of the stream, whereby the wheel is carried round.

FLOOD, among seamen, is when the tide begins to come up, or the water begins to rise• then they call it young flood; after which it is quarter-flood, half-flood, and high-flood.

FLORIN, is sometimes used for a coin, and sometimes for a money of account.

Florin, as a coin, is of different values, according to the different metals and different countries where it is struck. The gold florins are most of them of a very coarse alloy, some of them not exceeding thirteen or fourteen carats, and none of them seventeen and a half. As to silver florins, those of Holland are worth about 1*s*. 8*d*.

FLOS, in chemistry, the most subtile part of bodies, separated from the more gross parts by sublimation, in a dry form.

FLOUR, the meal of wheat corn, finely ground and sifted. Flour, when carefully analyzed, is found to be composed, 1. of fecula, which is insoluble in cold water, but soluble in hot water; 2. of gluten; 3. of a saccharine matter, susceptible of the spirituous fermentation

FLOWER, *flos*, among botanists and gardeners, the most beautiful part of trees and plants, containing the organs or parts of fructification. See Botany.

Flowers, *preserving of*. The method of preserving flowers in their natural beauty through the whole year has been much sought after. Some have attempted it by gathering them when dry, and not too much opened, and burying them in dry sand; but this, though it preserves their figure well, takes off from the liveliness of their colour. Muntingius prefers the following method to all others. Gather roses, or other flowers, when they are not yet thoroughly open, in the middle of a dry day: put them into a good earthen vessel glazed within; fill the vessel up to the top with them; and when full, sprinkle them over with some good French wine, with a little salt in it; then set them up in a cellar, tying down the mouth of the pot. After this they may be taken out at pleasure; and on setting them in the sun, or within reach of the fire, they will op[illegible] if growing naturally; and not only the colour, but the odour also, will be preserved.

and also g [illegible] one pound; armenian bole, two pounds; clean common sand, three pounds. Mix all well together; then gather fruit of any kind that is not fully ripe, with the stalk to each; put these, one by one, into a wide-mouthed glass, laying them in good order. Tie over the top with an oil-cloth, and carry them into a dry cellar, and set the whole upon a bed of the prepared matter of four inches thick in a box. Fill up the remainder of the box with the same preparation; and let it be four inches thick all over the top of the glass, and all round its sides. Flowers are to be preserved in the same sort of glasses, and in the same manner; and they may be taken up after a whole year as plump and fair as when they were buried.

Flower de lis, or *Flower de luce*, in heraldry, a bearing representing the lily, called the queen of flowers, and the true hieroglyphic of royal majesty.

FLUATS, in chemistry, salts first discovered by Scheele; they are distinguished by the following properties: (1.) When sulphuric acid is poured upon them, they emit acrid vapours of fluoric acid, which corrode glass. (2.) When heated, several of them phosphoresce. (3.) They are not decomposed by heat, nor altered by combustibles. (4.) They combine with silica by means of heat. Most of them are sparingly soluble in water.

FLUID, in physiology, an appellation given to all bodies whose particles easily yield to the least partial pressure, or force impressed.

FLUIDITY. The state of bodies when their parts are very readily moveable in all directions with respect to each other.

Before Dr. Black began to deliver his chemical lectures in Glasgow in 1757, it was universally supposed that solids were converted into liquids by a small addition of heat, after they had been once raised to the melting point, and, that they returned again to the solid state on a very small diminution of the quantity of heat necessary to keep them at that temperature. An attentive view of the phenomena of liquefaction and solidification gradually led this philosopher to observe their inconsistence with the then received opinions, and to form another, which he verified by direct experiments, and drew up an account of his theory, and the proofs of it.

The opinion which he formed was, that when a solid body is converted into a liquid, a much greater quantity of heat enters into it than is perceptible immediately after by the thermometer. This great quantity of heat does not make the body apparently warmer, but it must be thrown into it in order to convert it into a liquid; and this great addition of heat is the principal and most immediate cause of the fluidity induced. On the other hand, when a liquid body assumes the form of a solid, a very great quantity of heat leaves it without sensibly diminishing its temperature; and the state of solidity cannot be induced without the abstraction of this great quantity of heat. Or, in other words, whenever a solid is converted into a fluid, it combines with a certain dose of caloric, without any augmentation of its temperature; and it is this dose of caloric which occasions the change of the solid into a fluid. When the [illegible] occasions the change. Thus the combination of a certain dose of caloric with ice causes it to become water, and the abstraction of a certain dose of caloric from water causes it to become ice. Water then is a compound of ice and caloric; and in general all fluids are combinations of the solid, to which they may be converted by the application of cold, and a certain dose of caloric.

FLUOR *spar*, the native fluate of lime.

FLUORIC *acid*. The fusible spar, which is generally distinguished by the name of Derbyshire spar, consists of calcareous earth in combination with the acid at present under our consideration. If the pure fluor, or spar, be placed in a retort of lead or silver, with a receiver of the same metal adapted, and its weight of sulphuric acid be then poured upon it, the fluoric acid will be disengaged by the application of a moderate heat. This acid gas readily combines with water; for which purpose it is necessary that the receiver should previously be half filled with that fluid.

If the receiver be cooled with ice, and no water put in it, then the condensed acid is an intensely active liquid, first procured by M. Gay Lussac. The best account of it, however, has been given by Sir H. Davy. It has the appearance of sulphuric acid, but is much more volatile, and sends off white fumes when exposed to air. Its specific gravity is only 1.0609. It must be examined with great caution; for when applied to the skin it instantly disorganizes it, and produces very painful wounds. When potassium is introduced into it, it acts with intense energy, and produces hydrogen gas and a neutral salt; when lime is made to act upon it, there is a violent heat excited, water is formed, and the same substance as fluor spar is produced. With water in a certain proportion, its density increases to 1.25. When it is dropped into water, a hissing noise is produced with much heat, and an acid fluid not disagreeable to the taste is formed if the water be in sufficient quantity. It instantly corrodes and dissolves glass.

It appears extremely probable, from all the facts known respecting the fluoric combinations, that fluor spar contains a peculiar acid matter; and that this acid matter is united to lime in the spar, seems evident from the circumstance, that gypsum or sulphate of lime is the residuum of the distillation of fluor spar and sulphuric acid.

From the remarkable property fluoric acid possesses of corroding glass, it has been employed for etching on it, both in the gaseous state and combined with water. See Engraving.

FLUSTRA, a genus of insects of the order zoophyta; an animal of the polypus kind, proceeding from porous shells: stem fixed, foliaceous, membranaceous, consisting of numerous rows of cells united together, and woven like a mat. There are many species.

FLUTE, *fistula*, an instrument of music, the simplest of all those of the wind kind. It is played on by blowing it with the mouth, and the tones or notes are changed by stopping and opening the holes disposed for that purpose along its side. The ancient fistulæ, or flutes.

were made of reeds, afterwards of wood, and of metal; but how they were blown, whether as our flutes, or as hautboys, does not appear.

Flute, *German*, is an instrument entirely different from the common flute. It is not, like that, put into the mouth to be played, but the end is stopped with a tampion, or plug, and the lower lip is applied to a hole about two inches and a half, or three inches, distant from the end. This instrument is usually about a foot and a half long, rather larger at the upper end than the lower, and perforated with holes, besides that for the mouth, the lowest of which is stopped and opened by the little finger's pressing on a brass, or sometimes a silver key, but the modern flutes have often six or sometimes more keys.

FLUTES, or *flutings*, in architecture, perpendicular channels, or cavities, cut along the shaft of a column, or pilaster. See Architecture.

FLUX. A general term made use of to denote any substance or mixture added to assist the fusion of minerals. In the large way, limestone and fusible spar are used as fluxes. The fluxes made use of in assays, or philosophical experiments, consist usually of alkalis, which render the earthy mixtures fusible, by converting them into glass; or else glass itself in powder.

Alkaline fluxes are either the crude flux, the white flux, or the black flux. Crude flux is a mixture of nitre and tartar, which is put into the crucible with the mineral intended to be fused. The detonation of the nitre with the inflammable matter of the tartar, is of service in some operations; though generally it is attended with inconvenience on account of the swelling of the materials, which may throw them out of the vessel, if proper care be not taken either to throw in only a little of the mixture at a time, or to provide a large vessel.

White flux is formed by projecting equal parts of a mixture of nitre and tartar, by moderate portions at a time, into an ignited crucible. In the detonation which ensues, the nitric acid is decomposed, and flies off with the tartaric acid, and the remainder consists of the potash in a state of considerable purity. This has been called fixed nitre.

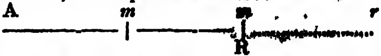
Black flux differs from the preceding, in the proportion of its ingredients. In this, the weight of the tartar is double that of the nitre; on which account the combustion is incomplete, and a considerable portion of the tartaric acid is decomposed by the mere heat, and leaves a quantity of coal behind, on which the black colour depends. It is used where metallic ores are intended to be reduced, and effects this purpose, by combining with the oxygen of the oxide.

The advantage of M. Morveau's reducing flux, seems to depend on its containing no excess of alkali. It is made of eight parts of pulverized glass, one of calcined borax, and half a part of powder of charcoal. Care must be taken to use a glass which contains no lead. The white glasses contain in general a large proportion, and the green bottle glasses are not perhaps entirely free from it.

FLUXION, in mathematics, denotes the velocity by which the fluents or flowing quantities increase or decrease; and may be considered as positive or negative, according as it relates to an increment or decrement.

The doctrine of fluxions, first invented by Sir Isaac Newton, is of great use in the investigation of curves, and in the discovery of the quadratures of curvilinear spaces, and their rectifications. In this method, magnitudes are conceived to be generated by motion, and the velocity of the generating motion is the fluxion of the magnitude. Thus, the velocity of the point that describes a line, is its fluxion, and measures its increase or decrease. When the motion of this point is uniform, its fluxion or velocity is constant, and may be measured by the space described in a given time, but when the motion varies, the fluxion of velocity at any given point is measured by the space that would be described in a given time, if the motion was to be continued uniformly from that term.

Thus, let the point m be conceived to move from A, and generate the variable right line Am, by a motion any how regulated; and let its velocity, when it arrives at any proposed position or point R, be such as would, were it to continue uniform from that point, be sufficient to describe the line Rr, in the given time allotted for the fluxion, then will Rr be the fluxion of the variable line Am, in the term or point R.



The fluxion of a plain surface is conceived in like manner, by supposing a given right line mn (Plate XVI. fig. 1.) to move parallel to itself, in the plane of the parallel and moveable lines AF and BG: for if, as above, Rr be taken to express the fluxion of the line Am, and the rectangle RrsS be completed; then that rectangle, being the space which would be uniformly described by the generating line mn, in the time that Am would be uniformly increased by mr, is therefore the fluxion of the generated rectangle Bm, in that position.

If the length of the generating line mn continually varies, the fluxion of the area will still be expounded by a rectangle under that line, and the fluxion of the absciss or base: for let the curvilinear space Anm (fig. 2) be generated by the continual and parallel motion of the variable line mn: and let Rr be the fluxion of the base or absciss Am, as before, then the rectangle RrsS, will be the fluxion of the generated space Amn. Because, if the length and velocity of the generating line mn were to continue invariable from the position RS, the rectangle RrsS would then be uniformly generated with the very velocity wherewith it begins to be generated, or with which the space Amn is increased in that position.

FLUXIONS, *notation of*, of invariable quantities, or those which neither increase nor decrease, are represented by the first letters of the alphabet, as a, b, c, d, &c. and the variable or flowing quantities by the last letters, as, v, w, x, y, z: thus, the diameter of a given circle may be denoted by a; and the sine of any arc thereof, considered as variable, by x. The fluxion of a quantity represented by a single letter, is expressed by the same letter with a dot or full point over it: thus, the fluxion of x is represented by $\dot{x}$, and that of y by $\dot{y}$. And, because these fluxions are themselves often variable quantities, the velocities with which they either increase or decrease, are the fluxions of the former fluxions, which may be called

second fluxions, and are denoted by the same letters with two dots over them, and so on to the third, fourth, &c. fluxions. The whole doctrine of fluxions consists in solving the two following problems, *viz* From the fluent, or variable flowing quantity given, to find the fluxion; which constitutes what is called the direct method of fluxions. 2. From the fluxion given, to find the fluent, or flowing quantity; which makes the inverse method of fluxions.

Fluxions, *direct method of*, the doctrine of this part of fluxions is comprised in these rules.

1. To find the fluxion of any simple variable quantity, the rule is to place a dot over it: thus, the fluxion of x is $\dot{x}$, and of y, $\dot{y}$. Again, the fluxion of the compound quantity $x+y$, is $\dot{x}+\dot{y}$: also the fluxion of $x-y$, is $\dot{x}-\dot{y}$.

2. To find the fluxion of any given power of a variable quantity, multiply the fluxion of the root by the exponent of the power, and the product by that power of the same root, whose exponent is less by unity than the given exponent. This rule is expresed more briefly, in algebraical characters, by $nx^{n-1}\dot{x}=$ the fluxion of x^n. Thus the fluxion of x^3 is $\dot{x}\times3\times x^2=3x\dot{x}$; and the fluxion of x^5 is $\dot{x}\times5\times x^4=5x^4\dot{x}$.

3. To find the fluxion of the product of several variable quantities, multiply the fluxion of each, by the product of the rest of the quantities; and the sum of the products, thus arising will be the fluxion sought. Thus, the fluxion of xy is $x\dot{y}+y\dot{x}$; that of xyz, is $\dot{x}yz+\dot{y}xz+\dot{z}xy$; and that of $vxyz$ is $vxyz+\dot{x}vyz+\dot{y}vxz+\dot{z}vxz$. Again the fluxion of $\overline{a+x}\times\overline{b-y}=ab+bx-ay-xy$, is $b\dot{x}-a\dot{y}-\dot{x}y-\dot{y}x$.

4. To find the fluxion of a fraction, the rule is, from the fluxion of the numerator, multiplied by the denominator, subtract the fluxion of the denominator multiplied by the numerator, and divide the remainder by the square of the denominator. Thus, the fluxion of $\frac{x}{y}$, is $\frac{y\dot{x}-x\dot{y}}{y^2}$; that of $\frac{x}{x+y}$, is $\frac{\dot{x}\times\overline{x+y}-\overline{\dot{x}+\dot{y}}\times x}{\overline{x+y}|^2}=\frac{y\dot{x}-x\dot{y}}{\overline{x+y}|^2}$; and that of $\frac{x+y+z}{x+y}$, or $1+\frac{z}{x+y}$, is $\frac{\dot{z}\times\overline{x+y}-\overline{\dot{x}+\dot{y}}\times z}{\overline{x+y}|^2}$; and so of others.

In the examples hitherto given, each is resolved by its own particular rule: but in those that follow, the use of two or more of the above rules is requisite; thus (by rule 2 and 3) the fluxion of x^2y^2 is found to be $2x^2y\dot{y}+2y^2x\dot{x}$; that of $\frac{x^2}{y^2}$, is found (by rule 2 and 4) to be $\frac{2y^2x\dot{x}-2x^2y\dot{y}}{y^4}$; and that of $\frac{x^2y^2}{z}$, is (by rule 2, 3, and 4,) found to be $\frac{\overline{2x^2y\dot{y}+2y^2x\dot{x}}\times z-x^2y^2\dot{z}}{z^2}$.

5. When the proposed quantity is affected by a coefficient, or constant multiplicator, the fluxion found as above must be multiplied by that coefficient or multiplicator: thus, the fluxion of $5x^3$, is $15x^2\dot{x}$; for the fluxion of x^3 is $3x^2\dot{x}$, which, multiplied by 5, gives $15x^2\dot{x}$. And, in the very same manner, the fluxion of ax^n will be $nax^{n-1}\dot{x}$.

Having explained the manner of determining the first fluxions of variable quantities, it is unnecessary in a work of this kind to enter upon the second, third, &c. fluxions. We shall therefore proceed to

Fluxions, *inverse method of*, or the manner of determining the fluents of given fluxions.

If what is already delivered, concerning the direct method, be duly considered, there will be no great difficulty in conceiving the reasons of the inverse method: though the difficulties that occur in this last part, upon another account, are indeed vastly great. It is an easy matter, or not impossible at most, to find the fluxion of any flowing quantity whatever; but, in the inverse method, the case is quite otherwise; for, as there is no method for deducing the fluent from the fluxion *a priori*, by a direct investigation; so it is impossible to lay down rules for any other forms of fluxions, than those particular ones, that we know, from the direct method, belong to such and such kinds of flowing quantities; thus, for example, the fluent of $2x\dot{x}$ is known to be x^2; because, by the direct method, the fluxion of x^2 is found to be $2x\dot{x}$: but the fluent of $y\dot{x}$ is unknown, since no expression has been discovered that produces $y\dot{x}$ for its fluxion. Be this as it will, the following rules are those used by the best mathematicians, for finding the fluents of given fluxions.

1. To find the fluent of any simple fluxion, you need only write the letters without the dots over them: thus the fluent of $\dot{x}$ is x, and that of $a\dot{x}+b\dot{y}$, is $ax+by$.

2. To assign the fluent any power of a variable quantity, multiplied by the fluxion of the root; first divide by the fluxion of the root; add unity to the exponent of the power, and divide by the exponent so increased; for, dividing the fluxion $nx^{n-1}\dot{x}$ by $\dot{x}$, it becomes nx^{n-1}; and adding 1 to the exponent $(n-1)$ we have nx^n; which, divided by n, gives x^n, the true fluent of $nx^{n-1}\dot{x}$. Hence, by the same rule, the fluent of $3x^2\dot{x}$ will be $=x^3$; that of $2x^5\dot{x}=\frac{x^6}{3}$; that of $y^{\frac{1}{2}}\dot{y}=\frac{2}{3}y^{\frac{3}{2}}$; that of $ay^{\frac{5}{3}}\dot{y}=\frac{3ay}{8}$; and that of $y^{\frac{m}{n}}\dot{y}=\frac{y^{\frac{m}{n}+1}}{\frac{m}{n}+1}=\frac{ny^{\frac{m+n}{n}}}{m+n}$; that of $\frac{a\dot{x}}{nx}$, or $a\dot{x}x^{-n}=\frac{ax^{1-n}}{1-n}$; that of $\overline{a+z}|^3\times\dot{z}=\frac{\overline{a+z}|^4}{4}$; and that of $\overline{a+z^m}|^n\times z^{m-1}\dot{z}=\frac{\overline{a+z^m}|^{n+1}}{m\times\overline{n\times1}|}$.

In assigning the fluents of given fluxions, it ought to be considered, whether the flowing quantity found as above, requires the addition or subtraction of some constant quantity, to render it complete: thus, for instance, the fluent of $nx^{n-1}\dot{x}$ may be either represented by x^n or by $x^n \pm a$; for a being a constant quantity, the fluxion of $x^n \pm a$, as well as of x^n, is $nx^{n-1}\dot{x}$.

Hence it appears, that the variable part of a fluent only can be assigned by the common method, the constant part being only assignable from the particular nature of the problem. Now to do this, the best way is to consider how much the variable part of the fluent first found, differs from the truth, when the quantity which the whole fluent ought to express is equal to nothing; then that difference, added to, or subtracted from, the said variable part, as occasion requires, will give the fluent truly corrected. To make this plainer by an example or two, let $\dot{y} = \overline{a+x}|^3 \times \dot{x}$. Here we first find $y = \frac{\overline{a+x}|^4}{4}$; but when $y = 0$, then $\frac{\overline{a+x}|^4}{4}$ becomes $= \frac{a^4}{4}$; since x, by hypothesis, is then $=0$: therefore $\frac{\overline{a+x}|^4}{4}$ always exceeds y by $\frac{a^4}{4}$; and so the fluent, properly corrected, will be $y = \frac{\overline{a+x}|^4 - a^4}{4} = a^3x + \frac{3a^2x^2}{2} + ax^3 + \frac{x^4}{4}$. Again, let $\dot{y} = \overline{a^m + x^m}|^n \times x^{m-1}\dot{x}$; here we first have $y = \frac{\overline{a^m + x^m}|^{n+1}}{m \times \overline{n+1}}$; and making $y=0$, the latter part of the equation becomes $\frac{\overline{a^m}|^{n+1}}{m \times \overline{n+1}} = \frac{a^{mn+m}}{m \times \overline{n+1}}$; whence the equation or fluent, properly corrected, is $y = \frac{\overline{a^m + x^m}|^{n+1} - a^{mn+m}}{m \times \overline{n+1}}$. Hitherto x and y are both supposed equal to nothing, at the same time; which will not always be the case: thus, for instance, though the sine and tangent of an arch are both equal to nothing, when the arch itself is so; yet the secant is then equal to the radius. It will therefore be proper to add some examples, in which the value of y is equal to nothing, when that of x is equal to any given quantity a. Thus, let the equation $\dot{y} = x^2\dot{x}$ be proposed; whereof the fluent first found is $y = \frac{x^3}{3}$; but when $y=0$, then $\frac{x^3}{3} = \frac{a^3}{3}$, by the hypothesis; therefore the fluent, corrected, is $y = \frac{x^3 - a^3}{3}$.

Again, suppose $\dot{y} = x^n\dot{x}$, then will $y = \frac{x^{n+1}}{n+1}$, which, corrected, becomes $y = \frac{a^{n+1} - x^{n+1}}{n+1}$. And, lastly, if $\dot{y} = \overline{c^3 + bx^2}|^{\frac{1}{2}} \times x\dot{x}$; then first, $y = \frac{\overline{c^3 + bx^2}|^{\frac{3}{2}}}{3b}$; therefore, the fluent corrected, is $y = \frac{\overline{c^3 + bx^2}|^{\frac{3}{2}} - \overline{c^3 + ba^2}|^{\frac{3}{2}}}{3b}$.

3. To find the fluents of such fluxionary expressions as involve two or more variable quantities, substitute, instead of such fluxion, its respective flowing quantity; and, adding all the terms together, divide the sum by the number of terms, and the qnotient will be the fluent. Thus, the fluent of $\dot{x}y + \dot{y}x = \frac{xy+xy}{2} = \frac{2xy}{2} = xy$: and the fluent of $\dot{x}yz + \dot{y}xz + \dot{z}yx = \frac{xyz + xyz + xyz}{3} = \frac{3xyz}{3} = xyz$. But it seldom happens that these kinds of fluxions, which involve two variable quantities in one term, and yet admit of known and perfect fluents, are to be met with in practice.

Having thus shewn the manner of finding such fluents as can be truly exhibited in algebraic terms, it remains now to say something with regard to those other forms of expressions involving one variable quantity only: which yet are so affected by compound divisors and radical quantities, that their fluents cannot be accurately determined by any method whatsoever. The only method with regard to these, of which there are innumerable kinds, is to find their fluents by approximation, which, by the method of infinite series, may be done to any degree of exactness.

Thus, if it were proposed to find the fluent of $\frac{a\dot{x}}{a-x}$, it becomes necessary to throw the fluxion into an infinite series, by dividing $a\dot{x}$ by $a-x$: thus, $a\dot{x} \div \overline{a-x} = \dot{x} + \frac{x\dot{x}}{a} + \frac{x^2\dot{x}}{a^2} + \frac{x^3\dot{x}}{a^3} + \frac{x^4\dot{x}}{a^4} +$, &c. Now the fluent of each term of this series, may be found by the foregoing rules to be $x + \frac{x^2}{2a} + \frac{x^3}{3a^2} + \frac{x^4}{4a^3} + \frac{x^5}{5a^4} +$, &c.

In order to shew the usefulness of fluxions, we shall give an example or two. 1. Suppose it were required to divide any given right line AB into two such parts, AC, CB, that their products are rectangles, may be the greatest possible. Let A B $=a$, and let the part A C, considered as variable (by the motion of C towards B) be denoted by x. Then B C being $=a-x$, we have A C × B C $= ax - xx$, whose fluxion $a\dot{x} - 2x\dot{x}$ being put $=0$, we get $a\dot{x} = 2x\dot{x}$: and, consequently, $x = \frac{1}{2}a$. Hence it appears that A C (or x) must be exactly one half of A B.

Ex. 2. To inscribe the greatest parallelo-

gram $DFGI$ in a given triangle ABC, fig. 3.

Draw BH perpendicular to AC; put $AC=a$, $BH=b$, $BE=x$, then $EH=b-x$: and by similar triangles, $b:a::x:DF=\frac{ax}{b}$; hence, the area $DFGI=\frac{ax}{b}\times\overline{b-x}=$ max. or $x\times\overline{b-x}=bx-x^2=$ max. ∴ $b\dot{x}-2x\dot{x}=0$; hence, $x=\frac{1}{2}b$; therefore $EH=\frac{1}{2}BH$.

Ex. 3. Let ABC represent a cone, AC the diameter of the base; to inscribe in it the greatest cylinder $DFGI$, fig. 4.

Put $p=,78539$, &c. then since $AC=a$. $BH=b$. $BE=x\frac{pa^2x^2}{b^2}=$ the area of the end DEF of the cylinder; hence, the content of the cylinder $=\frac{pa^2x^2}{b^2}\times\overline{b-x}=$ max. or $x^2\times\overline{b-x}=bx^2-x^3=$ max. . . $2bx\dot{x}-3x^2\dot{x}=0$; hence, $x=\frac{2}{3}b$· therefore $EH=\frac{1}{3}BH$. See Cylinder.

Ex. 4. To inscribe the greatest parallelogram $DFGI$ in a given parabola ABC, fig. 5.

Put $BH=a$, $p=$ the parameter, $x=BE$; then by the property of the parabola, $DE^2=px$, ∴ $DE=p^{\frac{1}{2}}x^{\frac{1}{2}}$, and $DF=2p^{\frac{1}{2}}x^{\frac{1}{2}}$; hence, the area $DFGI=2p^{\frac{1}{2}}x^{\frac{1}{2}}\times\overline{a-x}=$ max. or $x^{\frac{1}{2}}\times\overline{a-x}=ax^{\frac{1}{2}}-x^{\frac{3}{2}}=$ max. ∴ $ax^{-\frac{1}{2}}\dot{x}-\frac{3}{2}x^{\frac{1}{2}}\dot{x}=0$; hence, $\frac{a}{x^{\frac{1}{2}}}=3x^{\frac{1}{2}}$, or $a=3x$, ∴ $=\frac{1}{3}a$: consequently $EH=\frac{2}{3}BH$.

Ex. 5. To cut the greatest parabola DEF from a given cone ABC, fig. 6.

Let AGC be that of the diameter of the base which is perpendicular to DGF; now EG is parallel to AB; put $AC=a$, $AB=b$, $CG=x$, then $AG=a-x$: and by the property of the circle $DG=\sqrt{ax-x^2}$, ∴ $DF=2\sqrt{ax-x^2}$; also, by sim. △s, $a:b::x:GE=\frac{bx}{a}$; hence, we have the area of the parabola $=\frac{2}{3}\times\frac{bx}{a}\times2\sqrt{ax-x^2}=$ max. hence, $x\sqrt{ax-x^2}=$ max. or $x^2\times\overline{ax-x^2}=ax^3-x^4=$ max. ∴ $3ax^2\dot{x}-4x^3\dot{x}=0$, and $3a=4x$, ∴ $x=\frac{3}{4}a$.

FLY, in zoology. See Musca.

Fly, in mechanics, a cross with leaden weight at its ends, or rather a heavy wheel at right angles to the axis of a windlass, jack, &c.; by means of which the force of the power, whatever it may be, is not only preserved, but equally distributed in all parts of the revolution of the machine.

FLYERS, in architecture, such stairs as go straight, and do not wind round.

FLYING, the progressive motion of a bird, or other winged animal, in the liquid air. The parts of birds chiefly concerned in flying, are the wings, by which they are sustained or wafted along.

The manner of flying is thus: The bird first bends his legs, and springs with a violent leap from the ground; then opens and expands the joints of his wings, so as to make a right line perpendicular to the sides of his body: thus the wings, with all the feathers in them, constitute one continued lamina. Being now raised a little above the horizon, and vibrating the wings with great force and velocity perpendicularly against the subject air, that fluid resists those successions, both from its natural inactivity and elasticity, by means of which the whole body of the bird is produced. The resistance the air makes to the withdrawing of the wings, and consequently the progress of the bird, will be so much the greater, as the waft or stroke of the fan of the wing is longer.

Flying *pinion*, is part of a clock, having a fly, or fan, to gather air, and check the rapidity of the clock's motion, when the weight descends in the striking part.

FOCUS, in geometry and conic sections, is applied to certain points in the parabola, ellipsis, and hyperbola, where the rays reflected from all parts of these curves concur.

FOCI *of an ellipsis*, are two points in the longest axis, on which as centres the figure is described.

Focus *of an hyperbola*, is that point in the axis, through which the latus rectum passes; from whence if any two right lines are drawn meeting in either of the opposite hyperbolas, their difference will be equal to the principal axis.

Focus *of a parabola*, a point in the axis within the figure, distant from the vertex one fourth part of the latus rectum.

Focus, in optics, is the point in which the rays are collected, after they have undergone reflection or refraction.

FODDER, in the civil law, is used for a prerogative that the prince has, to be provided of corn and other meats for his horses, by the subjects, in his warlike expeditions.

Fodder, or *Fother*, in mining, a measure containing twenty-two hundred and a half-weight, though in London but twenty hundred weight.

FOG, or *Mist*, a meteor, consisting of condensed vapours, floating near the surface of the earth. If the vapours, which are raised plentifully from the earth and waters, either by the solar or subterraneous heat, at their first entrance into the atmosphere meet with cold enough to condense them to a considerable degree, their specific gravity is by that means increased, and thus they will be stopped from ascending; and either return back in form of dew or of drizzling rain, or remain suspended in the form of a fog. See Meteorology.

FOIL, among glass-grinders, a sheet of tin, with quicksilver, &c. laid on the backside of a looking-glass, to make it reflect.

Foil, among jewellers, a thin leaf of metal placed under a precious stone, in order to increase its brilliancy, or give it an agreeable and different colour.

FOLIATING *of looking-glasses*, the spreading the plates over, after they are polished, with amalgam, in order to reflect the image. It is performed thus: a thin blotting paper is spread on the table, and sprinkled with fine chalk; and then a fine lamina or leaf of tin called foil, is laid over the paper; upon this mercury is poured, which is to be distributed equally over the leaf with a hare's-foot, or cotton: over this is laid a clean paper, and

over that the glass plate, which is pressed down with the right-hand, and the paper drawn gently out with the left; this being done, the plate is covered with a thicker paper, and loaded with a greater weight, that the superfluous mercury may be driven out, and the tin adhere more closely to the glass. When it is dried, the weight is removed, and the looking glass is complete. Some add an ounce of marcasite, melted by the fire; and, lest the mercury should evaporate in smoke, pour it into cold water; and when cooled, squeeze it through a cloth or through leather.

Foliating *of globe looking-glasses*, is done as follows: Take five ounces of quicksilver, and one ounce of bismuth; of lead and tin half an ounce each; first put the lead and tin into fusion, then put in the bismuth, and when you perceive that in fusion too, let it stand till it is almost cold, and pour the quicksilver into it; after this, take the glass globe, which must be very clean, and the inside free from dust; make a paper funnel, which put into the hole of the globe, as near to the glass as you can, so that the amalgam when you pour it in may not splash, and cause the glass to be full of spots; pour it in gently, and move it about, so that the amalgam may touch every where.

FONTANESIA, a genus of the diandria monogynia class and order. There is one species, an herb of Syria.

FONTINALIS, water-moss, a genus of the natural order of musci, in the cryptogamia class of plants. There are six species, all of them natives of Britain. They grow on the brinks of rivulets, and on the trunks of trees. The most remarkable is the antipyretica, with purple stalks.

FOOD. See Materia Medica.

FOOT, a part of the body of most animals whereon they stand, walk, &c.

Animals are distinguished with respect to the number of their feet, into bipedes, two-footed: such are men and birds; quadrupeds, four-footed; such are most land-animals: and multipedes, or many-footed, as insects.

Foot, in the Latin and Greek poetry, a metre or measure composed of a certain number of long and short syllables. These feet are commonly reckoned twenty-eight, of which some are simple, as consisting of two or three syllables, and therefore called disyllabic or trisyllabic feet; others are compound, consisting of four syllables, and are therefore called tetrasyllabic feet.

Foot is also a long measure, consisting of twelve inches. Geometricians divide the foot into ten digits, and the digits into ten lines.

Foot, *square*, is the same measure both in breadth and length, containing 144 square or superficial inches.

Foot, *cubic*, or *solid*, is the same measure in all the three dimensions, length, breadth, and depth or thickness, containing 1728 cubic inches. The foot is of different lengths in different countries. The Paris royal foot exceeds the English by nine lines; the ancient Roman foot of the capitol, consisted of 4 palms, equal to $11\frac{7}{10}$ inches English; Rhineland or Leyden foot, by which the northern nations go, is to the Roman foot as 950 to 1000.

FORAGE, in military affairs, implies hay, straw, and oats, for the subsistence of the army horses.

FORCE, in mechanics, denotes the cause of the change in the state of a body when being at rest it begins to move, or has a motion which is either not uniform, or not direct.

FORCEPS, in surgery, &c. a pair of scissars for cutting off, or dividing, the fleshy membranous parts of the body, as occasion requires.

FORCER, or *forcing-pump*, in mechanics, is a kind of pump in which there is a forcer or piston without a valve. See Hydraulics.

FORCING, among gardeners, signifies the making trees produce ripe fruit before their usual time. This is done by planting them in a hot-bed against a south-wall, and likewise defending them from the injuries of the weather by a glass-frame. They should always be grown trees, as young ones are apt to be destroyed by this management.

FORE-*castle*, *of a ship*, that part where the foremost stands. It is divided from the rest by a bulk-head. See Ship.

Fore-*closed*, in law, signifies the being shut out, and excluded or barred, the equity of redemption on mortgages, &c.

FOREIGN *seamen*, serving two years on board British ships, whether of war, trade, or privateers, during the time of war, shall be deemed natural born subjects.

FORLORN-*hope*, in the military art, signifies men detached from several regiments, or otherwise appointed, to make the first attack in day of battle, or at a siege, to storm the counterscarp, mount the breach, &c.

FOREMAST of a ship, that which carries the fore-sail and fore-top sail yards.

Foremast-*men*, are those on board a ship that take in the top-sails, sling the yards, furl the sails, and take their turn at the helm, &c.

FORESTALLING, is the buying or bargaining for any corn, cattle, or other merchandize, by the way, before it comes to any market or fair, to be sold; or by the way, as it comes from beyond the seas, or otherwise, towards any city, port, haven, or creek of this realm, to the intent to sell the same again at a higher price.

FORESTER, a sworn officer of the forest, appointed by the king's letters patent, to walk the forest at all hours, watch over the vert and venison; also to make attachments and true presentments of all trespasses committed within the forest.

Forests, are waste grounds belonging to the king, replenished with all manner of beasts of chace on venery, which are under the king's protection, for the sake of his royal recreation; and there are particular laws, privileges, courts and officers belonging to the king's forests.

FORFEITURE, is a punishment annexed by law, to some illegal act or negligence in the owner of lands, tenements, or hereditaments, whereby he loses all his interest therein, and they go to the party injured, as a recompence for the wrong which either he alone or the public together with him have sustained.

FORFICULA, *earwig*, an insect of the coleoptera order. The wings of this insect are remarkably elegant, and are convoluted beneath their small sheaths in so curious a manner that they cannot be viewed without admiration: they are very large in proportion to the animal, transparent, and slightly iridescent. The earwig flies only by night, and it is not

without great difficulty that it can be made to expand its wings by day.

The usual food of the earwig consists of decayed fruit, and other vegetable substances; and it does not seem to be naturally carnivorous, though, if kept without proper nourishment, it will occasionally even attack and devour even its own species.

The popular dread in which this insect is held, on a supposition of its sometimes entering the cavity of the ear, and piercing the tympanum, is considered by some as problematical, though we believe there are instances of earwigs, which naturally creep into holes and apertures of every kind, having accidentally taken shelter in the ears of persons asleep, and occasioning great pain. The best means of expelling them, is to drop a small quantity of brandy or other spirit into the ear.

FORGE, properly signifies a small furnace, in which smiths and other artificers of iron or steel, &c. heat their metals red-hot, in order to soften and render them more malleable and manageable on the anvil.

Forge is also used for a large furnace, in which iron ore, taken out of the mine, is melted down; or it is more properly applied to another kind of furnace, where the iron ore, melted down and separated in a former furnace, and then cast into sows and pigs, is heated and fused over again, and beaten afterwards with large hammers, and thus rendered more soft, pure, ductile, and fit for use.

FORGERY, is where a person counterfeits the signature of another, with intent to defraud; which by the law of England is made a capital felony. This law is now extended by statute to the counterfeiting of almost every written instrument which is either a security for money or a public document or voucher upon which money may be received, or by which any one may be defrauded of money by the act of imposing upon him such a false instrument To enumerate the several statutes upon the subject, would here be impossible. It is generally punished with the most rigorous severity. We shall add a few detached points with respect to the cases of forgery, which may be useful to explain cases of frequent occurrence.

Forgery may be committed by making a mark in the name of another person. It may be also committed in the name of a person who never had existence. Thus, indorsing a real bill of exchange, with a fictitious name, is forgery, although the use of a fictitious name was not essential to the negociation.

FORGING, in smithery, the beating or hammering iron on the anvil, after having first made it red-hot in the forge, in order to extend it into various forms, and fashion it into works.

FORM, *printers*, an assemblage of letters, words and lines, ranged in order, and so disposed into pages by the compositor; from which, by means of ink and a press, the printed sheets are drawn. Every form is inclosed in an iron chase, wherein it is firmly locked by a number of pieces of wood; some long and narrow, and others of the form of wedges.

FORMA *pauperis*, is when any person has cause of suit, and is so poor that he cannot support the usual charges of suing at law or in equity In this case, upon his making oath that he is not worth five pounds his debts being paid, and bringing a certificate from some lawyer that he has just cause of suit, the judge admits him to sue in *forma pauperis*, that is. without paying fees.

FORMATION. In geology, an assemblage of mineral strata or masses, connected with each other, so as to form one whole or system, without any notable interruption, either in the period or nature of their production.

FORMIC *acid*. It has long been known that ants contain a strong acid, which they occasionally emit; and which may be obtained from the ants, either by simple distillation, or by infusion of them in boiling water, and subsequent distillation of as much of the water as can be brought over without burning the residue. After this it may be purified by repeated rectifications, or by boiling to separate the impurities; or after rectification it may be concentrated by frost.

This acid has a very sour taste, and continues liquid even at very low temperatures. Its specific gravity is 1.1168 at 68°, which is much denser than acetic acid ever is. It has been used by quacks as a cure for the tooth-ache.

FORMICA, *ant*, an insect of the hymenoptera class. According to Linnæus there are 18 species. The insects of this genus live in large societies, and are divided into males, females, and neutrals. The latter constitute the great or general assortment, and conduct the business of the nest, which is usually placed at a small distance from the surface in some slight elevation either prepared by the insects themselves, or previously formed by some other animals, as moles, &c. They feed both on animal and vegetable substances, devouring the smaller kind of insects, caterpillars, &c. as well as fruits of different kinds. They wander about all day in search of food or materials for the nest, and assist each other in bringing home what is too heavy or large for such as have attempted it. They bring out of their nest, to expose to the warmth of the sun, the newly hatched larvæ, and feed them till they are able to provide for themselves. In the evening they consume together whatever has been collected during the day, and do not, as is commonly supposed, lay up any store for the winter During the winter they remain in a state of torpor, and in the spring recommence their labour.

FORMULA, or **Formulary**, a rule or model, or certain terms prescribed or decreed by authority, for the form and manner of an act, instrument, proceeding, or the like.

Formula, in church history and theology, signifies a profession of faith.

FORSTERA, a genus of the triandria order, in the gynandria class of plants. There is but one species, an herbaceous plant of New Zealand.

FORT, in the military art, a small fortified place, environed with a moat, rampart, and parapet. Its use is to secure some high ground, or the passage of a river, to make good an advantageous post, to defend the lines and quarters of a siege, &c.

Forts are made of different figures and extents, according as the ground requires. Some are fortified with bastions, others with demi-

bastions. A fort differs from a citadel, as this last is built to command some town.

FORTIFICATION, may be defined the science of military architecture; and when applied to a city, town, or other place, it consists in the art of putting any of these in such a posture of preparation, by means of ramparts, parapets, ditches, and outworks, that each individual part defends, and is defended by, some other parts, so that a small number of men can hold out for a considerable time against a multitude.

Fortification is either regular or irregular. The regular is that built in a polygon, the sides and angles of which are all equal, being commonly about a musket shot from each other. Irregular fortification, on the contrary, is where the sides and angles are not uniform, equidistant, or equal.

I. OF REGULAR FORTIFICATION.

Authors in general agree as to the form, but they differ in respect to the construction of the parts. The chief of those who have written on this art, are Pagan, Blondel, Vauban, Cœhorn, Scheiter, Muller, Robins, Belidor, Folard, Le Blond, marshal Saxe, Tielke, and Belair.

It must be recollected by every engineer, that his views are not to be confined to the mere art of fortification. He must be able to take advantage of natural strength and position, chains of mountains and streams of water.

Blondel fortifies within the given polygon: he establishes two sorts of fortification; the great one, whose exterior side is 200 toises, and the lesser one, 170; because he will not have the line of defence exceed 140 toises, which is the greatest musket-shot, nor less than 120 toises, not to increase the number of bastions. He begins by the diminishing angle, which may be found by taking 90 degrees from the angle of the polygon, and by adding 15 degrees to the third of the remainder.

Vauban's method is divided into little, mean, and great; the little is chiefly used in the construction of citadels; the mean, in that of all sorts of towns; and the great, in particular cases only.

Scheiter's method is divided into the great, mean, and small sort. The exterior side of the polygon for the great sort is 200 toises, the mean sort, 180, and the small 160. The line of defence in the first is 140 toises, the second 130, and the third 120. This line is always razant.

Count Pagan makes the flank perpendicular to the line of defence, and by that means the flank so raised covers as much as possible the face of the opposite bastion; but notwithstanding this apparent advantage, the flank becomes too small, and is too much exposed to the enemies' batteries. This engineer acquired great reputation during the several sieges which he assisted in conducting under Louis XIII. This system, as improved by Mallet, differs very little from marshal Vauban's first system. Count Pagan has pointed out the method of building casemates in a manner peculiar to himself.

Vauban has judiciously steered between these different methods. He has drawn his flank in such a manner, that it does not stand too much exposed, nor does its collateral line of defence extend too far from the direct line of defence. He has effected this by lengthening out his flank, and giving it a circular form.

It cannot be disputed that large and extensive flanks and demigorges are superior to narrow and confined ones. The more capacious the flank is the better calculated will it prove for the disposition of a formidable train of artillery. From this conviction many writers, in their proposed systems of fortification, have added a second flank, in order to augment the line of defence; but they did not foresee that this second flank is not only incapable of covering the face of the opposed bastion, except in a very oblique and insecure direction, but that the right flank, or the flank of the bastion, is thereby more exposed to the enemy's batteries.

The prevailing system is to make the flanks of the bastion as wide as possible; without having recourse to a second flank, unless absolutely necessary. Those gorges are likewise best which are most capacious, because they afford space in the bastion for the construction of entrenchments within.

All parts of a fortification, which stands exposed to the immediate attacks of a besieging enemy, must be strong enough to bear the boldest attempts, and the most vigorous impressions. This is self evident, because it must be manifest that works are erected round a place for the specific purpose of preventing an enemy from getting possession of it. It consequently follows, that flanked angles are extremely defective when they are too acute, since their points may be easily flanked and destroyed by the besiegers' cannon.

The Dutch construct at sixty degrees; but according to Vauban's method, no work should be under seventy-five degrees, unless circumstances and situation should particularly require it.

The following is Mr. Vauban's method with regard to the fortification of towns.

Inscribe in a circle a polygon of as many sides as the fortification is designed to have fronts; let A B, fig. 7. Plate XVI, be one of the sides of half an hexagon, which bisect by the perpendicular C D; divide half of it A C into nine equal parts, and one of these into ten others; then these divisions will serve as a scale to construct all the parts of the fortification, and each of them is supposed to be a toise or fathom, that is, six French feet; and therefore the whole side A B is supposed to be 180 toises. As the dividing a line into so many equal parts is troublesome and tedious, it is more convenient to have a scale of equal parts, by which the works may be constructed.

If, therefore, in this case, the radius be taken equal to 180 toises, and the circle described with that radius being divided into six equal parts, or the radius being carried six times round, you will have an hexagon inscribed; A B being bisected by the perpendicular C D as before, set off 30 toises from C to D, and draw the indefinite lines A D G, B D F; in which take the parts A E, B H, each equal to 50 toises; from the centre E describe an arc through the point H, meeting A D in G, and from the centre H, describe an arc through the

point E, meeting B D in F; or, which is the same, make each of the lines E G, H F, equal to the distance E H; then the lines joining the points A, E, F, G, H, B, will be the principal or outline of the front.

If the same construction be performed on the other sides of the polygon, you will have the principal or outline of the whole fortification. If, with a radius of 20 toises, there be described circular arcs from the angular points B, A, M, T, and lines are drawn from the opposite angles E, H, &c. so as to touch these arcs, their parts *ab*, *bc*, &c. together with these arcs, will present the outline of the ditch.

Definitions.

1. The part FEALN is called the bastion.
2. A E, A L, the faces of the bastion.
3. E F, L N, the flanks.
4. F G, the curtain.
5. F N, the gorge of the bastion.
6. A G, B F, the lines of defence.
7. A B, the exterior side of the polygon.
8. C D, the perpendicular.
9. Any line which divides a work into two equal parts is called the capital of that work.
10. *a, b, c,* the counterscarp of the ditch.
11. A, M, the flanked angles.
12. H, E, L, the angles of the shoulder, or shoulder only.
13. G, F, N, the angles of the flank.
14. Any angle whose point turns from the place is called saliant angle, such as A, M and any angle whose point turns towards the place, re-entering angle, such as *b*, F, N.
15. If there be drawn two lines parallel to the principal or outline, the one at 3 toises distance, and the other at 8 from it, then the space *yx* included between the principal one and the farthest distant is called the rampart.

And the space *x*, contained by the principal line and that near to it, and which is generally stained black, is called the parapet.

16. There is a fine line drawn within four feet of the parapet, which expresses a step call banquette.

All works have a parapet of 3 toises thick, and a rampart of from 8 to 10, besides their slopes. The rampart is elevated more or less above the level of the place, from 10 to 20 feet, according to the nature of the ground and the particular constructions of engineers.

The parapet is a part of the rampart elevated from 6 to 7½ feet above the rest, in order to cover the troops which are drawn up there from the fire of the enemy in a siege; and the banquette is two or three feet higher than the rampart, or about four feet lower than the parapet; so that when the troops stand upon it, they may just be able to fire over the parapet.

17. The body of the place is all that which is contained within this first rampart; for which reason it is often said to construct the body of the place; which means, properly, the construction of the bastions and curtains.

18. All the works which are constructed beyond the ditch, before the body of the place, are called outworks.

II. Of irregular fortification.

The most essential principle in fortification consists in making all the fronts equally strong, so that the enemy may find no particular advantage in attacking either of them. But this can only occur in a regular work, situated in a plain, or even ground; consequently there are but few places which are not irregular and the great art here is, to remedy the defects and inconveniences occasioned by this circumstance.

If the situation to be fortified is an old town, inclosed by a wall or rampart, the engineer ought to consider well all the different circumstances of the figure, position, and nature of the ground, and to regulate his plan accordingly, so as to avoid as many disadvantages, on one hand, and to obtain as many advantages, on the other as possible. If there is a rampart without towers, it must be decided whether bastions ought not to be added, and ravelins and counter-guards constructed. Special care must be taken to make all the sides of the polygon nearly equal, and that the length of the lines of defence do not exceed the reach of musket-shot. Wherever the sides are inaccessible, either on account of a precipice, or marshy ground, they may be made much larger than those which are easy of access.

Places built on mountains or rocks should never be large: for their use is generally to guard passes or inlets into a country, and it is difficult to provide for a large garrison under such circumstances. When fortifications are to be placed in the neighbourhood of the sea, for the purpose of protecting trade, the first thing to be considered is their situation, which ought to afford a good harbour for shipping. When M. Vauban fortified near rivers, he always made the exterior side next to the water much longer than any of the others: for as that part is not so liable to be attacked, great and manifest advantages were of course derived from this circumstance,

To illustrate this method of M. Vauban's, we here give the plan of Hunninghen. That place was built for the sake of having a bridge over the Rhine, for which reason he made it only a pentagon; the side A B (fig. 8.) next to the river is 200 toises, and each of the others but 180.

About the space *a b c*, which lies before the front A B, is a stone wall; and the passages, are shut up with sluices, to retain the water in the ditches in dry seasons; and to prevent an enemy from destroying the sluice near the point *c*, whereby the water would run out and leave the ditches dry, the redoubt *y* was built in the little island hard by, in order to cover that sluice; without which precaution the place might be insulted from the river side, where the water is shallow in dry seasons.

The hornwork K, beyond the Rhine, was built to cover the bridge; but as this work cannot be well defended across the river, the hornwork H was made to support the other.

Before finishing the description of this plan, we shall shew how to find the long side A B. After having inscribed the two sides G E, G F, in a circle, draw the diameter C D, so as to be equally distant from the line joining the points E F. On this diameter set off 100 toises on

each side of the centre; from these points draw two indefinite perpendiculars to the diameter; then if from the points, E F, as centres, two arcs are described with a radius of 180 toises, their intersections A and B, with the said perpendiculars, will determine the long side A B. as likewise the other two F B and E A. In like manner may be found the long or short side of any polygon whatsoever.

The principal maxims of fortification are these, viz.

1. That every part of the works be seen and defended by other parts, so that the enemy cannot lodge any where without being exposed to the fire of the place.

2. A fortress should command all places round it; and therefore all the outworks should be lower than the body of the place.

3. The works farthest from the centre should always be open to those that are nearer.

4. The defence of every part should always be within the reach of musket-shot, that is, from 120 to 150 fathoms, so as to be defended both by ordnance and small fire-arms; for, if it is only defended by cannon, the enemy may dismount them by the superiority of their own, and then the defence will be destroyed at once; whereas, when a work is likewise defended by small-arms, if the one is destroyed, the other will still subsist.

5. All the defences should be as nearly direct as possible; for, it has been found by experience, that the soldiers are too apt to fire directly before them, without troubling themselves whether they do execution or not.

6. A fortification should be equally strong on all sides; otherwise the enemy will attack it in the weakest part, whereby its strength will become useless.

7. The more acute the angle at the centre is, the stronger will be the place.

8. In great places dry ditches are preferable to those filled with water, because sallies, retreats, succours, &c. are necessary; but, in small fortresses, wet ditches, that can be drained, are the best, as standing in need of no sallies.

FIELD-FORTIFICATION is the art of constructing all kinds of temporary works in the field, such as redoubts, field-forts, star-forts, triangular and square forts, heads of bridges, and various sorts of lines, &c. An army entrenched, or fortified in the field, produces, in many respects, the same effect as a fortress; for it covers a country, supplies the want of numbers, stops a superior enemy, or at least obliges him to engage at a disadvantage.

The knowledge of a field-engineer being founded on the principles of fortification, it must be allowed, that the art of fortifying is as necessary to an army in the field as in fortified places; and though the maxims are nearly the

can be readily obtained, viz. sand-bags, earth, and fascines ten feet long and one foot thick, which are fastened to the parapet, by means of five pickets driven obliquely into the bank.

When wood cannot be obtained for the fascines, the parapet must be clothed with turf, four inches thick, and a foot and a half square.

The palisades for fortifying the ditch ought to be nine or ten feet long and six inches thick.

The beams belonging to chevaux-de-frize should be twelve feet long, and six inches broad; the spokes seven feet long, four inches thick, and six inches distant from each other.

Gabions must be three or four feet high, and two or three feet in diameter.

FORTIN, **FORTLET**, or *field-fort*, a sconce or little fort, whose flanked angles are generally distant one from another 120 fathoms.

FORTS, *vitrified*, a very singular kind of structures found in the highlands and northern parts of Scotland, in which the walls have the appearance of being melted into a solid mass, so as to resemble the lava of a volcano, for which indeed they have been taken by several persons who have visited them.

FOSS, in fortification, a hollow place, commonly full of water, lying between the scarp and counterscarp, below the rampart; and turning round a fortified place or a post that is to be defended.

Foss-*way*, one of the four principal highways of England, that anciently led through the kingdom; supposed to be made by the Romans, having a ditch upon one side.

FOSSIL, in natural history, denotes in general all things dug out of the earth: whether they be natives thereof, as metals, stones, salts, earths, and other minerals; or extraneous, reposited in the bowels of the earth by some extraordinary means, as earthquakes, the deluge, &c. See MINERALOGY.

FOUL, or *foule*, in the sea language, is used when a ship has been long untrimmed, so that the grass-weeds, or barnacles grow to her sides under water. A rope is also foul when it is either tangled in itself or hindered by another, so that it cannot run or be over-hawled.

FOUL, imports also the running of one ship against another. This happens sometimes by the violence of the wind, and sometimes by the carelessness of those on board.

FOUNDATION, in architecture, is that part of a building which is under ground.

FOUNDATION, denotes also a donation or legacy, either in money or lands, for the maintainance and support of some community, hospital, school, lecture, &c.

FOUNDER, in a general sense, the person who lays a foundation, or endows a church, school, religious house, or other charitable institution. The founder of a church may preserve to himself the right of patronage, or presentation to the living.

FOUNDER, also implies an artist who casts metals in various forms, for different uses, as guns, bells, statues, printing characters, &c. whence they are denominated gun-founders bell-founders, figure-founders, letter-founders, founders of small works, &c.

FOUNDER, in the sea-language, a ship is said to founder, when she is so filled with water, that she cannot be freed of it; so that she can neither veer nor steer, and at last sinks.

FOUNDERY, or *foundry*, the art of casting all sorts of metals into different forms. It likewise signifies the work-house in which these operations are performed.

Foundery *in small works, or casting in sand.* The sand used for casting small works is, at first, of a pretty soft, yellowish, and clammy nature; but it being necessary to strew charcoal dust on the mould, it at length becomes of a black colour. This sand is worked over, and over, on a board, with a roller, and a sort of knife, and then passed through a sieve. This done, they take a wooden board of a length and breadth proportioned to the things to be cast, and putting a ledge round it, they fill it with sand, a little moistened, to make it duly cohere. Then they take either wood or metal models of what they intend to cast, and press them into the sand, so as to leave their impression there. Along the middle of the mould is laid half a small brass-cylinder, to form the chief canal for the metal to run through, when poured into the moulds; and from this chief canal are placed several others, which extend to each model or pattern placed in the frame. After this frame is finished they take out the patterns, by first loosening them all around, that the sand may not give way.

They then proceed to work the other half of the mould with the same patterns in just such another frame, only that it has pins, which, entering into holes that correspond to it in the other, make the two cavities of the pattern fall exactly on each other.

The frame thus moulded, is carried to the melter, who, after extending the chief canal of the counterpart, and adding the cross canals to the several models in both, and strewing mill-dust over them, dries them in a kind of oven for that purpose.

Both parts of the mould being dry, they are joined together by means of the pins; and to prevent their giving way, on account of the melted metal passing through the chief cylindrical canal, they are screwed or wedged up like a kind of press.

While the moulds are thus preparing, the metal is fusing in a crucible of a size proportionate to the quantity of metal intended to be cast.

Some of these small-work founder's furnaces are like a smith's forge, others stand a few feet under ground, for the more easily and safely taking out a weighty pot of metal; which is done by means of circular tongs that grasp round the top of the crucible. When the metal is melted, the workman pours it through the chief canal of each mould, which conveys it to every distinct pattern.

When the moulds are cool, the frames are unscrewed, or unwedged, and the cast-work taken out of the sand, which sand is worked over again for other castings.

The mould, for very large articles, is made of wet tempered loam, and must be built up by degrees, in a pit sufficiently deep to allow the highest part of the casting to be lower than the furnace in which the metal is melted, as the metal must run from the furnace along a channel on the ground to the mould.

Bell Foundery. In casting bells, the composition which is used, is termed bell-metal, which is made of copper, with one-sixth of tin, the usual proportion for church-bells; in clock bells, the proportion of tin is smaller, and a little zinc is added, especially for very small bells. The dimensions of the core, and the wax of bells, especially if it be a ring of several bells that is to be cast, are not left to the caprice of the workman, but must be measured on a kind of scale, which gives the height, aperture, and thickness necessary for the several tones required. It need not be added, that it is on the wax that the several mouldings, and other ornaments and inscriptions to be represented in relievo on the outside of the bell are formed. The clapper, or tongue, is not properly a part of the bell, but is furnished from other hands. In Europe, it is usually of iron, and is suspended in the middle of the bell. In China, it is only a huge wooden mallet, struck by force of arm against the bell; whence there can be but little of that harmony so much admired in some of our sets of bells.

Foundery *of great guns and mortar-pieces.* The method of casting these pieces is little different from that of bells.

Foundery-*letter.* See **Type.**

FOUNT, or *font*, among printers, a set or quantity of letters, and all the appendages belonging thereto, as numeral characters, quadrates, points, &c. cast by a letter-founder, and sorted. Founts are large or small, according to the demand of the printer, who orders them by the hundred weight, or by sheets. When a printer orders a fount of five hundred, he means that the fount, consisting of letters, points, spaces, quadrates, &c. shall weigh 500*lb.* When he demands a fount of ten sheets, it is understood, that with that fount he shall be able to compose ten sheets, or twenty forms, without being obliged to distribute. The founder takes his measures accordingly; he reckons 120*lb.* for a sheet, including the quadrates, &c. or 60*lb.* for a form, which is only half a sheet: not that the sheet always weighs 120*lb.*, or the form 60*lb*; on the contrary, it varies according to the size of the form; besides, it is always supposed that there are letters left in the cases. As, therefore, every sheet does not comprehemd the same number of letters, nor the same sort of letters, we must observe, that, as in every language some sounds recur more frequently than others, some letters will be in much more use, and oftener repeated than others, and consequently their cells or cases should be better stored than those of the letters which do not recur so frequently; thus, a fount does not contain an equal number of *a* and *b*, or of *b* and *c*, &c. the letter-founders have therefore a list or tariff, or, as the French call it, a police, by which they regulate the proportions between the different sorts of characters that compose a fount; and it is evident that this tariff will vary in different languages, but will remain the same for all sorts of characters employed in the same language.

FOURTEENTH, in music, the octave, replicate, of the seventh. A distance comprehending thirteeen diatonic intervals.

FOURTH, in music, a distance comprising three diatonic intervals: *i. e.* two tones and a half. The fourth is the third of the consonances in the order of their generation.

FOWL, denotes the largest sort of birds, whether domestic or wild, such as geese pheasants, partridges, turkeys, ducks, &c They are again divided into two kinds, viz, *land* and *water* fowl.

FOWLING. the art of taking or killing birds. It is either practised as an amusement by persons of rank and property, and then

principally consists in killing them with a light fire-arm, called a fowling-piece; and the diversion is secured to them by the game-laws; or it is practised for a livelihood, by persons who use nets and other apparatus The other artifices by which birds are taken, consist in imitating their voices, or leading them, by other means, into situations where they become entrapped by nets, or bird-lime, or otherwise.

Fowling *piece*, a light gun for shooting birds. That piece is always reckoned best which has the longest barrel, from 5½ to 6 feet, with a moderate bore; though every fowler should have them of different sizes, suitable to the game he designs to kill. The barrel should be well polished and smooth within, and the bore of an equal width from one end to the other; which may be proved by putting in a piece of pasteboard, cut of the exact roundness of the top; for if this goes down without stops or slipping, you may conclude the bore good.

FOX. See Canis.

Fox-*glove*. See Digitalis.

FRACTION. See Algebra.

FRACTURE, in surgery, a rupture of a bone, or a solution of continuity in a bone, when it is crushed or broken by some external cause.

FRAGARIA, the strawberry; a genus of the polygynia order, in the icosandria class of plants; and in the natural method ranking under the 35th order, senticosæ. The calyx is decemfid; the petals five; the receptacle of the seeds ovate, in the form of a berry and deciduous. There are three species, but only one is deserving of particular notice, viz. 1. the vesca, or cultivated strawberry. The principal varieties are, 1. The sylvestris, or wood strawberry, with oval sawed leaves, and small round fruit. 2. The Virginian scarlet, or Virginia strawberry with oblong oval sawed leaves, and a roundish scarlet coloured fruit. 3. The moschatta, or hautboy, or musky strawberry, having oval, lanceolate rough leaves, and large pale red fruit. 4. The chiloensis, or Chili strawberry, of which the Carolina is a variety with large, oval, thick, downy, leaves, large flowers, and very large firm fruit. 5. The alpina, alpine, or monthly strawberry, having small oval leaves, small flowers, and moderate-sized, oblong, pointed fruit. All these varieties are hardy, low, perennials, durable in root; but the leaves and fruit-stalks are renewed annually in spring. They flower in May and June, and their fruit comes to perfection in June, July, and August; the alpine kind continuing till the beginning of winter. They all thrive in any common garden soil, but best in a clayey soil, producing abundant crops annually without much trouble.

FRÆNUM, in anatomy, a term applied to some membraneous ligaments of the body.

Frænum *linguæ*, the ligament under the tongue, which sometimes ties it down too close to the bottom of the mouth; and then requires to be incised or divided, in order to give this organ its proper motion.

FRAISE, in fortification, a kind of defence consisting of pointed stakes, six or seven feet long, driven parallel to the horizon into the retrenchments of a camp, a half-moon, &c. and to prevent any approach or scalade,

FRANCHISE, in a general sense, a privilege or exemption from ordinary jurisdiction; as that for a corporation to hold pleas among themselves to such a value, or the like.

FRANK, or *franc*, meaning literally free from charges and impositions, or exempt from public taxes, has various significations in our ancient customs.

Frank, or *franc*, an ancient coin, of gold or silver, current in France. The value of the gold frank was somewhat more than that of the gold crown; the silver frank was a third of the gold one: this coin is now out of use, though the term is retained as the name of a money of account; being equivalent to 20 sols.

FRANKENIA, *sea-heath*, or *sea-chickweed*, a genus of the hexandria monogynia class of plants, the flower of which consists of five petals, with a plain limb: the fruit is an oval, unilocular capsule, covered by the cup, and containing a great many ovated very small seeds. There are three species of this weed.

FRANKINCENSE, is a gummy resin, the product of the juniperus lycia, consisting of equal parts of gum and resin; the first is soluble in water, the other in alcohol. It is brought from Turkey and the East Indies, but is principally collected in Arabia. It usually comes to us in drops, but in a very impure state, a hundred pounds not yielding more than from forty to fifty pounds of pure frankincense.

FRAUD, in law. All deceitful practices in defrauding or endeavouring to defraud another of his own right, by means of some artful device, contrary to the plain rules of common honesty, are condemned by the common law, and punishable according to the heinousness of the offence.

The distinction laid down, as proper to be attended to in all cases of this kind, is this, that in such impositions or deceits, where common prudence might guard persons from the offence, it is not indictable, but the party is left to his civil remedy; but where false weights or measures are used, or false tokens produced, or such measures taken to defraud or deceive, as people cannot by any ordinary care or prudence be guarded against, there it is an offence indictable.

Persons convicted of obtaining money or goods by false pretences, or sending threatening letters to extort money or goods, may be punished by fine and imprisonment, or by pillory, whipping, or transportation. 30 G. II. c. 24.

FRAXINUS, the *ash*, a genus of the diœcia order, in the polygamia class of plants, and in the natural method ranking under the 44th order, sepiariæ. There are four species, of which the most useful is the common ash, which is so well known that it needs no description. This tree flourishes best in groves, but grows very well in rich soil in open fields. It bears transplanting and lopping. In the north of Lancashire they lop the tops of these trees to feed the cattle in autumn when the grass is on the decline, the cattle peeling off the bark as food. It is hard and tough, and is much used to make the tools employed in husbandry. The ashes of the wood afford very good potash. The bark is used in tanning calf-skin.

FREEDOM *of a corporation*, the right of enjoying all the privileges and immunities belonging to it.

The freedom of cities, and other corporations is regularly obtained by serving an apprentice-

ship of seven years; but it is also sometimes purchased with money, and sometimes conferred by way of compliment.

FREEHOLD, may be in deed or in law. A freehold in deed is actual seisin of lands or tenements in fee-simple, fee-tail, or for life. A freehold in law is a right to such lands or tenements before entry or seisure.

FREESTONE, a whitish stone dug up in many parts of England, that works like alabaster, but is more hard and durable, being of excellent use in building, &c.

FREEZE, or *frieze,* in commerce, a coarse kind of woollen stuff, or cloth for winter wear; so called as being freezed or naped on one side.

Freezing, in philosophy, is the fixing a fluid body into a firm or solid mass by the action of cold.

Having under the article congelation explained the process of freezing water by means of the air-pump, we shall here subjoin a table of freezing mixtures which will be found capable of producing cold, without the aid of ice, sufficient for all useful and philosophical purposes, in any part of the world, and at any season.

Table of freezing mixtures.

	Mixtures.	Parts.	*Thermom. sinks.*
1.	Muriate of ammonia	5	from 50° to 10°.
	Nitre	5	
	Water	16	
2.	Muriate of ammonia	5	from 50° to 3°.
	Nitre	5	
	Sulphate of soda	8	
	Water	16	
3.	Sulphate of soda	5	from 50° to 0°.
	Diluted sulphuric acid	4	
4.	Snow	1	from 52° to 0°.
	Common salt	1	
5.	Snow or pounded ice	2	from 0° to—5°.
	Common salt	1	
6.	Potash	4	from 32° to—51°.
	Snow	3	
7.	Muriate of lime	3	from 32° to—50°.
	Snow	2	
8.	Muriate of lime	2	from 0° to—66°.
	Snow	1	
9.	Muriate of lime	3	from—40° to—73°.
	Snow	1	
10.	Diluted sulphuric acid	10	from—68° to—91°.
	Snow	8	

When any of these substances are to be employed as freezing mixtures, the salts should be used fresh crystallized, and reduced to fine powder · and it will perhaps be found most convenient to observe the proportions which are set down in the table. Suppose it is wanted to produce a degree of artificial cold equal to—50°, which is the temperature produced from 32° by the seventh freezing mixture. The substances employed, namely, the muriate of lime and the snow, must be previously cooled down to the temperature of 32°, or any degree below it. This may be done by placing them separately in the third freezing mixture, the sulphate of soda, and diluted sulphuric acid, which reduces the temperature from 50° to 3°; or in the fourth freezing mixture of snow and common salt, which reduces the temperature from 32° to 0°. The materials thus cooled down, are then to be mixed together as quickly as possible, when, if the experiment succeed, the temperature will fall from 32° to—50°, as in the seventh freezing mixture. The vessels which are employed for these processes should be very thin, and made of the best conductors of heat. Vessels of tin plate answer the purpose, and when acids are to be used, they may be lined with wax, which will secure them sufficiently against their action. They should be of no larger dimensions than just to contain the materials.

Freezing *point.* See **Thermometer.**

FREIGHT, or *fraight,* in navigation and commerce, is the consideration of money agreed to be paid for the use or hire of a ship, or, in a larger sense, the burthen of such ship.

The freight is most frequently determined for the whole voyage, without respect to time: sometimes it depends on time; in the former case it is either fixed at a certain sum for the whole cargo, or so much per ton, barrel, bulk, or other weight or measure, or so much per cent. on the value of the cargo.

FRESCO, a method of painting in relievo on walls, so as to endure the weather. It is performed with water-colours on fresh plaster; or a wall laid with mortar not yet dry. This sort of painting has a great advantage by its incorporating with the mortar, and drying along with it, becomes very durable.

FRESHES, in sea-language, denote the impetuosity of an ebb-tide, increased by heavy rains, and flowing out into the sea, often discolouring it to a considerable distance, and forming a line that separates the two colours, and which may be distinctly perceived for a great length along the coast.

FRET, in architecture, a kind of knot, or ornament, consisting of two lists or fillets variously interlaced or interwoven, and running at parallel distances equal to their breadth.

Fret, in heraldry, a bearing composed of six bars, crossed, and variously interlaced.

Fret, in music, signifies a kind of stop on some instruments, particularly bass-viols and lutes.

FRICTION, in mechanics, the rubbing of the parts of engines and machines against each other, by which means a great part of their effect is destroyed.

It is hardly possible to lay down general rules concerning the quantity of friction; since it depends upon a multiplicity of circumstances, as the structure, firmness, elasticity, &c. of the bodies rubbing against each other. Some authors make friction upon a horizontal plane, equal to one third of the weight to be moved; whilst others have found it to be considerably less.

Two objects must however be observed, *viz.* the loss of power which is occasioned by it, and the contrivances which have been made, and are in use, for the purpose of diminishing its effects.

A body of a horizontal plane should be capable of being moved by the application of the least force; but this is not the case, and the principal causes which render a greater or less quantity of force necessary for it are, 1st, the

roughness of the contiguous surfaces; 2dly, the irregularity of the figure, which arises either from the imperfect workmanship, or from the pressure of one body upon the other; 3dly, an adhesion or attraction which is more or less powerful according to the nature of the bodies in question; and 4thly, the interposition of extraneous bodies; such as moisture, dust, &c.

Innumerable experiments have been made for the purpose of determining the quantity of friction, which is produced in particular circumstances: But the results of experiments, which have been made do not agree; nor is it likely they should, since the least difference of smoothness or polish, or of hardness, or, in short, of any of the various concurring circumstances, produces a different result.

Mr. Vince, who has made many experiments on friction, infers,

1st, That friction is an uniformly retarding force in hard bodies, not subject to alteration by the velocity; except when the body is covered with cloth, woollen, &c. and in this case the friction increases a little with the velocity.

2dly, Friction increases in a less *ratio* than the quantity of matter or weight of the body. This increase, however, is different for the different bodies, more or less; nor is it yet sufficiently known, what proportion the increase of friction bears to the increase of weight.

3dly, The smallest surface has the least friction, the weight being the same. But the ratio of the friction to the surface is not yet accurately known.

The methods of obtaining the important object of diminishing the friction, are of two sorts, *viz.* either by the interposition of particular unctuous, or oily substances between the contiguous moving parts, or by particular mechanical contrivances. Olive-oil is the best, and perhaps the only substance that can be used in small works, as in watches and clocks, when metal works against metal. But in large works the oil is liable to drain off, unless some method is adopted to confine it. Therefore, for large works tallow is mostly used, or grease of any sort, which is useful for metal, as well as for wood. In the last case tar is also frequently used. The mechanical contrivances which have been made, and are in use, for the purpose of diminishing the effects of friction, consist either in avoiding the contact of such bodies as produce much friction, or in the interposition of rollers, *viz.* cylindrical bodies, between the moving parts of machines, or between moving bodies in general. Such cylinders derive, from their various size and application, the different names of rollers, friction wheels, and friction rollers.

FRIGATE, among seamen, a ship of war, light built, and that is a good sailer. All ships of war that carry from 20 to 50 guns are called frigates.

FRINGELLA, in ornithology, a genus belonging to the order of passeres. The bill is conical, straight, and sharp pointed. There are no less than 108 species comprehended under this genus, distinguished principally by varieties in their colour. The following are the most remarkable.

1. The *carduelis*, or goldfinch, with the quill feathers red forwards, and the outermost without any spots; the two outermost are white in the middle, as the rest are at the point. The young bird, before it moults, is grey on the head; and hence it is termed by the bird-catchers a grey-pate. There is a variety of goldfinches called by the London bird-catchers a cheverel, from the manner in which it concludes its jerk. It is distinguished from the common sort by a white streak, or by two, sometimes three, white spots under the throat. The note of the goldfinch is very sweet, and they are much esteemed on that account, as well as for their great docility. Towards winter, they assemble in flocks, and feed on seeds of different kinds, particularly those of the thistle. They are fond of orchards, and frequently build in an apple or pear-tree; the nest is very elegantly formed of fine moss, liverworts, and bents, on the outside; lined first with wool and hair, and then with the goslin or cotton of the sallow. The goldfinch lays five white eggs, marked with deep purple spots on the upper end, and has two broods in the year.

2. The *cœlebs*, or chaffinch, has black limbs, and the wings white on both sides; the three first feathers of the tail are without spots, but two of the chief are obliquely spotted. It has its name from delighting in chaff. This species entertain us agreeably with its song very early in the year, but towards the latter end of the summer assumes a chirping note. Both sexes continue with us the whole year. They lay four or five eggs of a dull white colour, tinged and spotted with deep purple. They are caught in plenty in flight-time.

3. The *montifringilla*, or brambling, has a yellow bill tipped with black; the head, hind part of the neck, and back, are black; the throat, fore part of the neck, and breast, pale rufous orange; lower part of the breast and belly white; the quill feathers brown with yellowish edges; the tail a little forked: the legs grey. This species migrates into England at certain seasons, but does not build here. It is frequently found among chaffinches, and sometimes come in vast flocks. They are also seen at certain times in vast clouds in France. They are said to be particularly fond of beech mast, but will also eat seeds of various other kinds. This species is found throughout Europe, and is common in the pine forests of Russia and Siberia.

4. The *domestica*, or sparrow, has the prime feathers of the wings and tail brown, the body variegated with grey and black, and a single white streak on the wings. These well-known birds are proverbially salacious, and have three broods in a year. They are every where common about houses, and build in every place they can find admittance to. They make a slovenly nest; generally a little hay ill put together, but lined well with feathers, where they lay five or six eggs of a reddish white colour spotted with brown. They sometimes build in the neighbouring trees, in which case they take more pains with the nest: and not unfrequently they expel the martins from theirs, to save the trouble of constructing one of their own.

5. The *spinus*, or siskin, has the prime feathers of the wings yellow in the middle, and the four first chief tail-feathers without spots; but they are yellow at the base, and black at the points. In Sussex it is called the barley-

bird, because it comes to them in barley-seed time. We are informed that it visits these islands at very uncertain times, like the gross-beak, &c. It is a very tame and docile species, and is often kept and paired with the Canary-bird, with which it breeds freely.

6. The *linota*, or linnet, has the bottom of the breast of a fine blood-red, which heightens as the spring advances. These birds are much esteemed for their song. They feed on seeds of different kinds, which they peel before they eat; the seed of the linum or flax is their favourite food; whence the name of the linnet tribe. They breed among furze and white thorn; the outside of their nest is made with moss and bents, and lined with wool and hair. They lay five whitish eggs, spotted like those of the goldfinch.

7. The *cannabina*, or greater red-pole, is less than the common linnet, and has a blood-coloured spot on the fore-head, and the breast of the male is tinged with a fine rose-colour. These birds are frequent on our sea-coasts, and are often taken in flight-time near London: it is a familiar bird, and is cheerful soon after it is caught.

8. The *linaria*, or lesser red-pole, is about half the size of the last, with a rich spot of purplish red on the forehead; the breast is of the same colour, but less bright. This species is known about London by the name of stone red-pole. Whole flocks of them, mixed with the siskin, frequent places where alders grow, for the sake of picking the catkins. This species seems to be in plenty throughout Europe, from the extreme parts of Russia to Italy. It is common in Greenland, and in America it is likewise well known.

9. The *montium*, or twite, is about the size of a linnet. It has the feathers of the upper part of the body dusky, those on the head edged with ash-colour, the others with brownish red: the rump is pale crimson; the wings and tail are dusky, the tips of the greater coverts and secondaries whitish; the legs pale brown. The female wants the red mark on the rump. Twites are taken in the flight-season near London, along with other linnets.

10. The *Canaria*, or Canary-bird, has a whitish body and bill, with the prime feathers of the wings and tail greenish. It was originally peculiar to those islands to which it owes its name; the same that were known to the ancients by the addition of the Fortunate.

FRIT, or **Fritt**, in the glass manufacture, is the matter or ingredients of which glass is to be made, when they have been calcined or baked in a furnace.

There are three kinds of frit: the first crystal frit, or that for clear glass, is made with salt of pulverine and sand. The second and ordinary frit is made of the bare ashes of pulverine or barilla, without extracting the salt from them. This makes the ordinary white or crystal glass. The third is frit for green glasses, made of common ashes, without any preparation.

FRITH, in its most usual acceptation, signifies an arm of the sea; such are the frith of Forth or of Edinburgh, the frith of Clyde, Murray frith, &c.

FRITILLARIA, *fritillary*, a genus of the monogynia order, in the hexandria class of plants, and in the natural method ranking under the 10th order, coronariæ. There are five species, all of them bulbous rooted flowery perennials, producing annual stalks from about one foot to a yard or more high, terminated by large, bell-shaped, liliaceous flowers, of a great variety of colours.

FRIZING *of cloth*, a term in the woollen manufactory, applied to the forming of the nap of a cloth or stuff into a number of little hard burrs or prominences, covering almost the whole ground. This process is now performed by machinery, which renders it more perfect than could be done by the old method.

FROG. See Rana.

Frog-*fish* of Surinam, a very singular animal, of which there is no specimen in the British or any public museum. In Surinam these fishes are called jakjes. They are cartilaginous, of a substance like our mustela, and exquisite food: they are formed with regular vertebræ, and small bones all over the body divided into equal parts; are first darkish, and then grey; their scales make a beautiful appearance.

FROST. See Congelation and Freezing.

FROTH-*spit*, or **Cuckow-spit**, a name given to a white froth or spume, very common in the spring. It forms the nidus of a species of cicada.

FRUSTUM, in mathematics, a part of some solid body separated from the rest.

The frustrum of a cone is the part that remains, when the top is cut off by a plane, parallel to the base, and is otherwise called a truncated cone.

The frustum of a globe or sphere is any part of it cut off by a plane, the solid contents of which may be found by this rule. To three times the square of the semidiameter of the base add the square of its height; then multiplying that sum by the height, and this product multiplied by .5236, gives the solidity of the frustum.

FUCUS, a name given by the ancients to certain dyes and paints. By this name they called a purple sea-plant used by them to dye woollen and linen cloths of that colour. The dye was very beautiful, but not lasting; for it soon began to change, and in time went wholly off. This is the account Theophrastus gives of it.

Fucus, in the Linnæan system of botany, is a genus of the order of algæ, belonging to the cryptogamia class of plants. The most remarkable species are,

1. The *serratus*, serrated fucus, or sea-wrack. This is frequent at all seasons of the year upon the rocks at low-water-mark. It consists of a flat, radical leaf, about two feet long; the branches half an inch wide, serrated on the edges with dents of unequal size. A small species of coralline, called by Linnæus sertularia pumila, frequently creeps along the leaf. All the species of fucus afford a quantity of impure alkaline salts; but this much less than some others, eight ounces of the ashes yielding only three of fixed salt.

2. The *vesiculosus*, bladder fucus, common sea-wrack, or sea-ware It grows in great abundance on the sea-rocks about low-water-mark. It has the same habit, colour, and substance as the foregoing, but the edges of the

leaf havs no serratures. In the surface are spherical, or oval bladders hairy within, growing generally in pairs, but often single in the angles of the branches, which are most probably air-bladders to buoy up the plant in the water. On the summits of the leaves appear tumid vesicles about three quarters of an inch long, sometimes oval and in pairs, sometimes single and bifid, with a clear viscid mucus interspered with downy hairs. This species is an excellent manure for land; for which purpose it is often applied in the maritime parts of Scotland and other countries. But the most beneficial use to which the fucus vesiculosus is applied, is in making potash or kelp, a work much practised in the Western Isles. There is great difference in the goodness and price of this commodity, and much care and skill required in properly making it. That is esteemed the best which is hardest, finest grained, and free from sand or earth.

Its virtues in the medical way have been much celebrated by Dr. Russell, in his Dissertation concerning the use of Sea-water in the Diseases of the Glands.

3. The *plicatus*, matted or Indian-grass fucus, grows on the sea-shores in many places both of England and Scotland. It is generally about three or four, but sometimes six inches long. Its colour, after being exposed to the sun and air, is yellowish or auburn; its substance pellucid, tough, and horny; resembling Indian grass.

4. The *palmatus*, palmated or sweet fucus, commonly called dulse or dilse. This grows plentifully on the sea-coasts of Scotland and the adjoining islands. Its substance is membranaceous, thin, and pellucid; the colour red, sometimes green, with a little mixture of red; its length generally about five or six inches, but varies from three inches to a foot; its manner of growth fan-shaped, or gradually dilated from the base upwards.

5. The *esculentus*, eatable fucus, or bladder-locks, commonly called tangle in Scotland, is likewise a native of the British shores. It is commonly about four feet long, and seven or eight inches wide. The substance is thin, membranaceous, and pellucid; the colour green or olive. The root consists of tough cartilaginous fibres.

6. The *saccharinus*, sweet fucus, or sea-belt, is very common on the sea-coast. The substance of this is cartilaginous and leathern, and the leaf is quite ribless.

7. The *ciliatus*, ciliated or ligulated fucus, is found on the shores of Ionia and other places, but is not common. The colour of this is red, the substance membranous and pellucid, without rib or nerve; the ordinary height of the whole plant about four or five inches.

8. The *prolifer*, or proliferous fucus, is found on the shores of the western coast, adhering to shells and stones. The colour is red; the substance membranaceous, but tough, and somewhat cartilaginous, without rib or nerve, though thicker in the middle than at the

[illegible] The *pinnatifidus* jagged fucus, or pepper-dilse, is frequent on sea-rocks which are covered by the tides both on the eastern and western coasts. It is of a yellow olive-colour, often tinged with red. The substance is cartilaginous, but yet tender and transparent; the height about two or three inches.

10. The *plocamium*, or pectinated fucus, is frequent on the sea-rocks, and in basins of water left by the recess of the tides. Its natural colour is a most beautiful bright red, or purple, but is often variegated with white or yellow. Its substance is cartilaginous, but extremely thin, delicate, and transparent; its height commonly about three or four inches.

11. The *filum*, thread-fucus, or sea-laces, is found on the sea-rocks, and waving under the water like long strings, frequent on many parts of the coast. The substance of this is opaque and cartilaginous, but not difficult to be broken. The colour, when recent, a dull olive-green; when dry, nearly black; and, when exposed for some time on the shores to the sun and air, it becomes yellow, straw-coloured, or white.

12. The *giganteus*, or gigantic fucus, is a native of the Straits Le Maire, and grows on rocky ground, which in those countries is distinguished from sand or ooze by the enormous length of the sea-weeds that grow upon it. The leaves are four feet long, and some of the stalks, though not thicker than a man's thumb, are 120.

FUEL. Dr. Black divides fuel into five classes; the first comprehends the fluid inflammable bodies; the second, peat or turf; the third, charcoal of wood; the fourth, pit-coal charred: and the fifth, wood, or pit-coal, in a crude state, and capable of yielding a copious and bright flame.

FUGUE, in music, a term derived from the Latin word fuga, a flight, and signifying a composition either vocal, or instrumental, or both, in which one part leads off some determined succession of notes called the subject, which, after being answered in the fifth and eighth by the other parts, is interspersed through the movement, and distributed amid all the parts in a desultory manner, at the pleasure of the composer; sometimes accompanied by other adventitious matter, and sometimes by itself. There are distinct descriptions of fugues; the simple, the double, and the counter fugue.

FUIRENA, a genus of the triandria monogynia class and order. There is one species, a grass of Surinam.

FULCRUM, in mechanics, the prop or support by which a lever is sustained. See Mechanics.

FULGORA, or lantern-fly, an insect belonging to the hemiptera order.

1. The *fulgora lanternaria*, or Peruvian lantern-fly, is undoubtedly one of the most curious of insects. It is of a very considerable size, measuring nearly three inches and a half from the tip of the front to that of the tail, and about five inches and a half between the extremities of the wings when expanded: the body is of a lengthened oval shape, and divided into several rings or segments; the head is nearly equal to the length of the rest of the animal; the ground-colour is an elegant yellow, with a strong tinge of green in some parts, and marked with numerous bright red-brown stripes and spots; the wings are very large, of a yellow colour, elegantly varied with brown undulations and spots, and the lower pair are decorated by a very large spot on the

middle of each, the iris or border of the spot being red, and the centre half red and half white; the head or lantern is pale yellow, with longitudinal red stripes. This beautiful insect is a native of Surinam and many other parts of South America, and during the night diffuses so strong a phosphoric splendour from its head or lantern, that it may be employed for the purpose of a candle or torch; and it is said that three or four of the insects, tied to the top of a stick, are frequently used by travellers for that purpose.

2. The *fulgora candelaria* is a much smaller species than the preceding, and is a native of China. It measures nearly two inches in length, and two inches and a half in breadth, with the wings expanded: the body is oval, and the head produced into a long horn-shaped process: the colours are very elegant, the head and horn being of a fine reddish brown or purple, and covered with numerous white specks; the thorax is of a deep or orange-yellow, and the body black above, but deep yellow beneath; the wings are oval, the upper pair blackish, with very numerous and close-set green reticulations, dividing the whole surface into innumerable squares or marks, and are farther decorated by several yellow bars and spots; the under wings are orange-coloured, with broad black tips.

3. *Fulgora diadema* is an Indian species, and is distinguished by having a long, spiny, front, with a triple division at the tip; its colour is brown, with red and yellow variegations; in size it is nearly similar to that of the preceding species.

FULICA, the *gallinule* and *coot*, in ornithology, a genus of birds of the order of grallæ. There are 25 species, 18 of which belong to the gallinule division, distinguished by having the toes furnished with broad scalloped membranes, and seven comprehend the coots which have the toes divided to their origin. The following species are among the most distinguished.

1. The *chloropus*, or common gallinule, is in length about 14 inches, and has a bald forehead and broad flat toes. It gets its food on grassy banks, and borders near fresh waters. It builds upon low trees and shrubs by the water-side, breeding twice or thrice in a summer, and, when the young are grown up, drives them away to shift for themselves.

2. The *porphyrio*, or purple gallinule, is about the size of a domestic fowl. It is more or less common in all the warmer parts of the globe. The female makes her nest among the reeds in the middle of March; lays three or four eggs, and sits from three to four weeks. It will feed on many things, such as fruit, roots and grain: but will eat fish with avidity, dipping them into the water before it swallows them.

3. The *atra* or common coot, has a bald forehead, a black body, and lobated toes, and is about 15 inches in length. They frequent lakes and still rivers; making their nests among the rushes, with grass, reeds, &c. floating on the water, so as to rise and fall with it. They lay five or six large eggs, of whitish hue, sprinkled over with rust-coloured spots. The young, when just hatched, are very deformed, and the head mixed with a red coarse down. In winter the channel near Southampton is sometimes almost covered with them. Their food is small fish and water-insects; but they will sometimes eat the roots of the bulrush: they are said likewise to eat grain.

4. The *aterrima*, or greater coot, is of a larger size than the last, and its plumage is blacker. This species is said to be found in Lancashire and Scotland; but is more plentiful on the continent, being found in Russia and the western parts of Siberia.

FULLER, a workman employed in the woollen manufactories to mill or scour cloths, serges, and other stuffs, in order to render them more thick, compact, and durable.

FULLER'S *earth*, in natural history, a species of clay, of a greyish ash-coloured brown, and has generally something of a greenish cast. It is hard and firm, of a compact texture, of a rough surface that adheres slightly to the tongue. It is very soft to the touch, not staining the hands, nor breaking easily between the fingers. Its constituents are, 53 silica, 10 alumina, 1.25 magnesia, 0.50 lime, 0.10 muriate of soda, trace of potash, oxide of iron 9.75, water 24.—*Klaproth.* Bergmann found 24 alumina, and only 0.7 oxide of iron. In England it occurs in beds, sometimes above, sometimes below, the chalk formation; at Rosswein in Upper Saxony, under strata of greenstone slate; and in different places in Germany it is found immediately under the soil. The best is found in Buckinghamshire and Surry.

FULLING, the art or act of cleansing, scouring, and pressing cloths, stuffs, and stockings, to render them stronger, closer, and firmer; called also milling. The fulling of cloths and other stuffs is performed by a kind of water-mill, thence called a fulling or scouring-mill. These mills, except in what relates to the mill-stones and hopper, are much the same with corn-mills: and there are even some which serve indifferently for either use corn being ground, and cloths fulled, by the motion of the same wheel. Whence in some places, particularly in France, the fullers are called millers; as grinding corn and milling stuffs at the same time.

The method of fulling cloths and woollen stuffs with soap is this: A coloured cloth, of about 45 ells, is to be laid in the usual manner, in the trough of a fulling mill, without first soaking it in water, as is commonly practised in many places. To full this trough of cloth, 15 pounds of soap are required, one half of which is to be melted in two pails of river or spring water. This solution is to be poured by little and little upon the cloth, in proportion as it is laid in the trough: and thus it is to be fulled for at least two hours; after which it is taken out and stretched. This done, the cloth is immediately returned into the same trough, without any new soap, and there fulled two hours more. Then taking it out, they wring it well, to express all the grease and filth. After the second fulling, the remainder of the soap is dissolved as in the former, and cast four different times on the cloth, remembering to take out the cloth every two hours to stretch it. When it is sufficiently fulled, and brought to the quality and thickness required it is scoured in hot water, in the trough till it

is quite clean. As white cloths full more easily and in less time than coloured ones, a third part of the soap may be spared.

FULMINATION. In a variety of chemical combinations it happens, that one or more of the principles assume the elastic state with such rapidity, that the stroke against the displaced air produces a loud noise. This is called fulmination, or much more commonly, detonation.

Fulminating gold, and fulminating powder, are the most common substances of this kind, except gunpowder. For the latter of these, see the article GUNPOWDER. The fulminating powder is made by triturating in a warm mortar, three parts by weight of nitre, two of carbonate of potash, and one of flowers of sulphur. Its effects, when fused in a ladle, and then set on fire, are very great. The whole of the melted fluid explodes with an intolerable noise, and the ladle is commonly disfigured, as if it had received a strong blow downwards.

If a solution of gold be precipitated by ammonia, the product will be fulminating gold. Less than a grain of this, held over the flame of a candle, explodes with a very sharp and loud noise. This precipitate, separated by filtration, and washed, must be dried without heat, as it is liable to explode with no great increase of temperature; and it must not be put into a bottle closed with a glass stopple, as the friction from this would expose the operator to the same danger.

FULMINATING *silver*.—Dissolve fine silver in pale nitric acid, and precipitate the solution by lime water; decant the fluid, mix the precipitate with liquid ammonia, and stir it till it assumes a black colour; then decant the fluid, and leave it in the open air to dry. This product is fulminating silver, which when once obtained cannot be touched without producing a violent explosion. It is the most dangerous preparation known, for the contact of fire is not necessary to cause it to detonate. It explodes by mere touch. Its preparation is so hazardous, that it ought not to be attempted without a mask, with strong glass eyes, upon the face. No more than a single grain ought at any time to be tried as an experiment. This was invented by Berthollet.

M. Chenevix has invented a fulminating silver, not so dangerous as that just mentioned. It is thus prepared: Diffuse a quantity of alumina through water, and let a current of chlorine gas pass through it for some time. Then digest some phosphate of silver on the solution of the chlorite of alumnia, and evaporate it slowly. The product obtained will be a hyperchlorate of silver, a single grain of which, in contact with two or three of sulphur, will explode very violently with the slightest friction.

FULMINATING *mercury*. The mercurial preparations which fulminate, when mixed with sulphur, and gradually exposed to a gentle heat, are well known to chemists: they were discovered, and have been fully described, by Mr. Bayen.

Brugnatelli and Van Mons have likewise produced fulminations by concussion, as well by nitrate of mercury and phosphorus as with phosphorus and most other nitrates. Cinnabar likewise is amongst the substances which, according to Fourcroy and Vauquelin, detonate by concussion with chlorate of potash.

M. Ameilon had, according to Berthollet, observed, that the precipitate obtained from nitrate of mercury, by oxalic acid, fuses with a hissing noise.

But mercury, and most, if not all its oxides, may, by treatment with nitric acid and alcohol, be converted into a whitish crystallized powder, possessing all the inflammable properties of gun-powder, as well as many peculiar to itself. This discovery was made by Mr. Howard.

FUMIGATION, in medicine, a process by means of which the nitrous and other mineral acids, in a state of vapour, are dispersed through the apartments of those who lie sick of infectious fevers. When this fumigation is undertaken on board ships, the ports and scuttles are closed, a number of pipkins, containing hot sand, are procured, and into each is plunged a small tea-cup, containing half an ounce of sulphuric acid. As soon as the acid is properly heated, an equal quantity of pulverised nitre is added, and the mixture stirred with a glass rod. The vapour resulting from the decomposition of nitre ascends, and is by the nurses conducted to every part of the apartment, which not only abates the malignity of the fever, but effectually stops the progress of infection.

FUNCTION, the act of fulfilling the duties of any employment.

FUNCTION, *animal*, applied to the actions of the body, is by physicians divided into vital, animal, and natural. The vital functions are those necessary to life, and without which the individual cannot subsist; as the motion of the heart, lungs, &c. The natural functions are such as it cannot subsist any considerable time without them, as the digestion of the aliment, and its conversion into blood. Under animal functions are included the senses of touching, tasting, &c. memory, judgment, and voluntary motion.

FUNDS, *public*. When the practice was first adopted of borrowing money for the state, the produce of some particular tax was generally appropriated, as the fund out of which the principal and interest of the debt was to be discharged. The possession of the acknowledgment given by government for the money advanced, establishing a right to receive the payments from the fund originally agreed upon, the sale of these securities was considered as a sale of the claim upon the fund, and as the acknowledgments given were of different kinds, the general appellation of the provision on which they rested was found more convenient for purposes of business: thus the sale and purchase of the government securities was commonly called the sale or purchase of the public funds, till at length the expression has so far varied from its original signification, that instead of meaning the revenue out of which public debts or the interest of them is payable, it denominates the capital of such debts, in which sense it is generally used.

FUNDAMENTAL *note*, in music, the principal note in a song, or composition, to which all the rest are in some measure adapted, and by which they are swayed · it is otherwise called the key to the song

FUNGI, *mushrooms*. The name of one of the seven families, or tribes, into which all vegetables are divided by Linnæus in his Philosophia Botanica. In the sexual system, they constitute the fourth order of the class cryptogamia. It is the name also of the fifty-eighth order of the Fragments. These plants are rarely branched, sometimes creep, but are most commonly erect. Such as are furnished with branches have them of a light spungy substance like cork. Mushrooms differ from the fuci in that those, which, like the fuci, have their seeds contained in capsules, are not branched as that numerous class of sea-weed is. The greatest part of mushrooms have no root; some, in their stead, have a number of fibres, which, by their inosculations, frequently form a net with unequal meshes, some of which produce plants similar to their parent vegetable. The stamina in these plants are still undetermined. The seeds are either spread over the surface of the plant, or placed in cavities which are open, and resemble the open capsules of some of the fuci. In mushrooms which are branched, the seeds are frequently visible by the naked eye, and always to be distinctly observed with the assistance of a good microscope. See Acaricus.

FUNGUS, in surgery, denotes any spungy excrescence.

FURLONG, a long measure, equal to ⅛ of a mile or forty poles. It is also used in some law books, for the eighth part of an acre.

FURLOUGH, in the military language, a licence granted by an officer to a soldier, to be absent for some time from his duty.

FURNACE, an utensil to raise and maintain a vehement fire in, whether of coal or wood; they are built of bricks, made of sand and clay, or of cast-iron, or of iron plates, which are coated to the thickness of an inch with Windsor loam; various kinds of fire-proof furnaces, for making small experiments, may be prepared from black-lead crucibles.

The burning of the fuel is kept up in the furnace either by a natural current of air, which is caused by the fire itself, and such a furnace is called an air wind-furnace; or it is done by compressed air, conveyed to the furnace by a large bellows, as in blast-furnaces. See Laboratory.

FURR, in commerce, signifies the skin of several wild beasts, dressed in alum with the hair on, and used as a part of dress by princes, magistrates, and others. The kinds most in use are those of the ermine, sable, castor, hare, rabbit, &c.

Furrs, in heraldry, a bearing which represents the skins of certain beasts, used as well in the doublings of the mantles belonging to the coat armours, as in the coat-armour themselves.

FURZE, or *furze-bush*. See Ulex.

FUSANUS, a genus of the polygamia monœcia class and order. There is one species, a tree of the Cape.

FUSEE, in clock-work, is that part drawn by the spring, and about which the chain or string is wound.

FUSILEERS, in the British service, are soldiers armed like the rest of the infantry, with this difference only, that their musquets are shorter and lighter than those of the battalion and the grenadiers.

FUSION, the action of fire, or more properly, of caloric, on solid bodies, by which they are caused to pass into the state of fluidity; and a body rendered liquid by fire is said to be in fusion, to flow, to melt.

Some bodies cannot be rendered fluid by any degree of heat which we are able to produce. These are called infusible, apyrous or fire-proof. Several of them may, however, be fused by adding other bodies, which on account of this property are called fluxes. Such addition is called at the smelting-works dressing of the ores.

FUSTIAN, in commerce, a kind of cotton stuff, which seems as if it was whaled on one side.

FUSTIC, or *yellow wood*. This wood, the *morus tinctoria*, is a native of the West Indies. It affords much yellow colouring matter, which is very permanent.

FUTTOCKS, in a ship, the timbers raised over the keel, or the encompassing timbers that make her breadth.

G.

G. In grammar, is the seventh letter, and fifth consonant of the English alphabet. It has two sounds, viz. the hard sound as in the word *game*: and the soft as in *George*.

As a numeral, it anciently denoted 400; and with a dash over it, thus, $\overline{\text{G}}$, 400,000. In music it is the mark of the treble cleft; and, from its being placed at the head of Guido's scale, that scale too; [illegible] name of gamut.

GABEL, a word met with in old records, signifying a tax, rent, custom, or service, paid to the king, or other lord.

GABIONS, in fortification, baskets made of ozier-twigs, of a cylindrical form, six feet high, and four wide; which being filled with earth, serve as a shelter from the enemy's fire. See Fortification.

GABRES, Guebres, or Gaurs, worshippers of fire, a religious sect which has subsisted in Asia from a very ancient period. They are met with principally in Surat, Bombay, and along the coast of Malabar. The moral character of these people is universally esteemed; they are quiet, inoffensive, and industrious, and are most respected where they are best known. Their munificence and liberality to men of all tribes, is perhaps unexampled in the history of mankind. They do not bury their dead, but expose them to birds of prey in a kind of circular building, called a *dakhme*, which is open

at top: these buildings present a spectacle too horrible to bear description, but which is viewed by the Gaurs with enthusiastic delight.

GAD, among miners, a small punch of iron, with a long wooden handle, used to break up the ore

GAD-FLY, or *breeze-fly* See OESTRUS.

GADOLINITE, a mineral first found in a white felspar in the quarry of Ytterby in Sweden, and received the name gadolinite, because Gadoline was the chemist who first ascertained its composition. Colour perfect black, passing sometimes to brown. Found in mass. Fracture conchoidal. Scratches quartz. Brittle. With borax it melts into a topaz-yellow glass. Sp. gr. 4.0 to 4.2. It intumesces very much before the blowpipe, and at length melts into an imperfect slag, which is magnetical. It loses its colour in nitric acid, and gelatinizes. Its constituents are 25.8 silica, 45 yttria, 16.69 oxide of cerium, 10.26 oxide of iron, 0.60 volatile matter.

GADUS, *cod*, in ichthyology, a genus of fishes belonging to the order of jugulares. There are 17 species, the principal of which are,

1. *Gadus morhua*, or common cod. This highly important and prolific species is an inhabitant of the northern seas, where it resides in immense shoals, performing various migrations at stated seasons, and visiting in succession the different coasts of Europe and America.

The general rendezvous of the cod-fish is on the banks of Newfoundland, and the coasts of Cape Breton, Nova Scotia, and New England. They prefer those situations on account of the quantity of worms produced in those sandy bottoms, but another cause of this attachment to those spots is their vicinity to the polar seas, where they return to spawn: there they deposit their roe in full security, but want of food forces them, as soon as the first more southern seas are open, to repair thither for subsistence. Few are taken north of Iceland, but on the

The cod grows to a very large size. Mr. Pennant instances a specimen taken on the British coast which weighed 78 lbs. and measured 5 feet 8 inches in length, and 5 feet in girth round the shoulders; but the general weight is from about 14 to 40 pounds.

The cod is of a moderately long shape, with the abdomen very thick and prominent: the head is of moderate size, and the eyes large: the jaws of equal length, the lower one bearded at the tip by a single cirrus; in the jaws and palate are numerous sharp teeth: the dorsal and anal fins are rather large, the pectoral small: the ventral small and slender: the tail of moderate size and even at the end, the first ray on each side being short and bony. The usual colour of this fish is cinerous on the back and sides, and commonly spotted with yellow: the belly silvery; but the colours occasionally vary very considerably; the lateral line, which is one of the principal distinctive [illegible], whitish, and the scales are somewhat larger than in others of the genus.

The food of the cod is either small fish, worms, testaceous or crustaceous animals, such as crabs, &c. Its digestion is so powerful as to dissolve the greatest part of the shells it swallows. The fishermen are well acquainted with the use of the air bladder or sound of this fish, and dexterously perforate the living fish with a needle, in order to let out the air contained in that part. The sounds when salted, are reckoned a delicacy. A species of isinglass is also prepared from this part of the fish by the natives of Iceland.

2. *Gadus æglefinus*, or haddock, is distinguished from the rest of this genus by having a forked tail, and the lower jaw longer than the upper: the colour of the body is silvery, with a dusky cast on the back: the lateral line is black, and on each side at some distance beyond the head, and above the pectoral fins, is a black spot: the tip of the lower jaw is furnished with a cirrus: the eyes are large; the scales small, round, and closely attached to the skin.

This species is a native of the northern seas, where, like the cod, it assembles in prodigious shoals, visiting particular coasts at stated seasons; the shoals are sometimes near six miles in length, and more than a mile in breadth. The haddock is taken in vast quantities about Heligoland, and thence sent to Hamburgh. Its food consists of small fishes, worms, and sea insects. It spawns in the month of February.

3. *Gadus callarius*, or dorse, is a somewhat smaller species than the haddock, rarely exceeding the weight of two pounds.

The head is smaller than that of the haddock, and is marked by several spots, which in the summer are generally brown, and in the winter black.

The dorse is a native of the northern seas, as well as of the Mediterranean and the Baltic. It is taken both by the line and the net, and is highly esteemed as an article of food.

4. *Gadus barbatus*, or whiting-pout, according to Mr. Pennant, never grows to a large size, rarely exceeding a foot in lengh, and is distinguished from all others by its great depth; one of the size above mentioned being near

5. *Gadus minutus*, or poor, is a small species, seldom exceeding six or seven inches in length, and of a more slender form than any of the preceding kinds. It is found in the Baltic and the Mediterranean.

6. *Gadus merlangus*, or whiting, with three dorsal fins, but with a beardless mouth. The whiting is the most delicate as well as the most wholesome of the genus, but does not grow to a large size, the usual length being about ten or twelve inches, and the largest scarcely exceeding twenty. It is a fish of an elegant make: the body is rather long, and covered with small, round silvery scales: the head and back are of a pale brown, and the sides slightly streaked with yellow. This fish is an inhabitant of the Baltic, and the northern seas, and is found in some parts of the Mediterranean Vast shoals appear in the British seas during the spring; keeping at the distance of from about half a mile to that of three from the shore: they are caught in vast numbers by the line, and afford excellent diversion. their food consists of small fishes, sea insects, and worms: they are said to be particularly fond of sprats and young herrings, with which the fishermen generally bait for them.

7. *Gadus carbonarius*, or coal-fish, when

full grown, is readily distinguished by its very dark colour, though in this respect it sometimes varies: it is of a moderately long and elegant shape, with a small head, sharpened snout, and lower jaw exceeding the upper in length: when full grown, the head, dorsal fins, tail, and upper parts of the body are of a dusky black, which gradually softens into a silvery tinge as it approaches the abdomen. It is an inhabitant of the Baltic, the northern and Mediterranean seas: it is common on the most of our rocky and deep coasts, but particularly on those of Scotland and the Orkneys.

8. *Gadus merluccius*, or hake, with two dorsal fins. The head is large, broad and flat at the top, but compressed on the sides: the opening of the mouth wide, and the jaws armed with two rows of long, curved teeth, intermixed with smaller ones: the palate is also furnished with a row of teeth on each side; the pectoral and ventral fins are of a moderate size, and the tail is nearly even at the end; the lateral line commences by several small warts beyond the head, and is continued in a straight direction to the tail: the usual length of the hake is from one to two feet.

This fish is an inhabitant of the Mediterranean and northern seas, in both of which its fishery is very considerable: it is salted and dried in the manner of cod, haddock, &c.

9. *Gadus molva*, or the ling, takes its name from its length, being corrupted from the word long; the body is slender; the head flat. The usual size is from three to four feet, but is sometimes seen of the length of seven feet: in colour it varies, being sometimes of an olive hue on the sides and back, and sometimes cinerous: the abdomen is white, as are also the ventral fins, and the dorsal and anal are edged with white: the tail is marked near the end with a transverse black bar, and tipped with white.

The ling is an inhabitant of the northern seas, and forms in many places a considerable article of commerce. Vast quantities of this fish are salted for exportation as well as for home consumption.

10. *Gadus lota*, or the burbot, highly esteemed for its superior delicacy, is an inhabitant of clear lakes and rivers, and is found in many parts of Europe and Asia. In our own country it occurs chiefly in the lakes of the northern counties, but it is said to arrive at its greatest perfection in the lake of Geneva, where it is found in great plenty.

The burbot is considered as a very voracious fish, preying on all the smaller fishes, as well as on frogs, worms, and aquatic insects: the largest of those which are taken in England have been rarely known to exceed the weight of three pounds, but in some parts of Europe they are found of more than double that weight, and of the length of three feet or more.

GÆRTNERE, a genus of the decandria monogynia class and order. There is one species, a shrub of the East Indies.

GAGE, in law-books, the same with surety or pledge.

GAGE, in the sea-language. When one ship is to windward of another, she is said to have the weather-gage of her. They likewise call the number of feet that a vessel sinks in the water, the ship's gage: this they find by driving a nail into a pike near the end, and putting it down beside the rudder till the nail catches hold under it; then as many feet as the pike is under water, is the ship's gage.

GAGE, among letter-founders, a piece of box, or other hard wood, variously notched; the use of which is to adjust the dimensions, slopes, &c. of the different sorts of letters. There are several kinds of these gages, as the flat-gage, the face-gage, and italic-gage, &c.

GAGE, *sliding*, a tool used by mathematical instrument-makers, for measuring and setting off distances. It is also of use in letter-cutting, and making of moulds.

GAGE, *sea*, an instrument invented by Dr Hales, and Dr. Desaguliers, for finding the depth of the sea.

GAHNIA, a genus of the monogynia order, in the hexandria class of plants. There are two species, herbs of New Zealand and Otaheite.

GALANTHUS, the *snow-drop*, a genus of the monogynia order, in the hexandria class of plants, and in the natural method ranking under the ninth order, spathaceæ. There is but one species, viz. the nivalis; which is a bulbous rooted flowery perennial, rising but a few inches in height, and adorned at top with small tripetalous flowers of a white colour. There are three varieties, viz. the common single-flowered snow-drop, the semi-double snow-drop, and the double snow-drop. They are beautiful little plants, and are much valued on account of their early appearance, often adorning the gardens in January or February, when scarcely any other flower is to be seen.

GALARDIA, a genus of the class and order syngenesia polygamia frustranea. There is one species; an annual of Louisiana.

GALAXIA, a genus of the monodelphia triandria class and order. There are two species, herbs of the Cape.

GALAXY, in astronomy, the via lactea, or milky way, a tract of a whitish colour, and considerable breadth, which runs through a great compass of the heavens, sometimes in a double, but for the most part in a single stream; it is composed of a vast number of stars, too minute or too remote from the earth, to be distinguished by the naked eye; but which are discovered in all parts of it, in great numbers, by the assistance of the telescope.

GALBANUM exudes from the *bubon galbanum*. This juice comes over in masses, composed of white, yellowish, brownish-yellow, and brown tears, unctuous to the touch, softening betwixt the fingers; of a bitterish, somewhat acrid, disagreeable taste, and a very strong smell; generally full of bits of stalks, leaves, seeds, and other foreign matters.

GALEGA, a genus of the class and order diadelphia decandria. There are 19 species, some of them known by the name of goats' rue.

GALENIA, a genus of the digynia order, the octandria class of plants, and in the natural method ranking under the 13th order, succulentæ. There are two species, shrubs of the Cape.

GALENA, in mineralogy, sulphuret of lead, is very common, and is found both in masses and crystallized. The primitive form of its crystals is a cube.

Its colour is commonly blueish grey, like lead, but brighter. Streak blueish grey and metallic. Lustre metallic. Texture foliated

Fragments cubical. Soft; but brittle. Specific gravity 7.22 to 7.587 Effervesces with nitric and muriatic acids. It is composed of from .45 to .83 lead, and from .086 to .16 of sulphur. It generally contains some silver, and sometimes also antimony and zinc.

GALEOPITHECUS. *Colugo.* A genus of quadrupeds. The generic character is front-teeth, in the upper jaw none; in the lower six, short, broad, distant, pectinated; canine-teeth very short, triangular, broad, sharp, serrated; grinders four, truncated, and muricated with conical protuberances; flying-skin surrounding the body, limbs, and tail.

Galeopithecus volans, the flying colugo, is a native of the Molucca and Philippine islands, where it is said to frequent woody places, and to feed principally on fruits. It almost constantly resides on trees, and spreads its membranes, and balances itself to the place it aims at in a gentle manner; but in ascending it uses a leaping pace. The whole length of the animal is about three feet: the breadth, when expanded, nearly the same: the tail is slender and about a span long. The membrane, or expansile skin, by which it is enabled to fly, is continued on each side, from the neck to the fore feet; thence to the hind feet; and again to the tip of the tail. The whole upper side of the animal is generally of a deep ash-colour; and the whole under side, both of the body and membrane, is of a yellowish colour. The head is long; the mouth rather small; the tongue, fleshy, broad, rounded, attenuated on the edges, and ciliated with papillæ. The ears are small, round, membranaceous, and marked internally by numerous semicircular transverse streaks. The legs are clothed with a soft yellow down: there are five toes on each foot, united by a common membrane, and terminating in large, crooked claws. This animal is called by the Indians caguang, colugo, and gigua. It was first described by Bontius in his History of Java.

GALIUM, a genus of the monogynia order, in the tetrandria class of plants, and in the natural method ranking under the 47th order, stellatæ. There are 48 species, of which the most remarkable are, the verum or yellow lady's bed-straw, and the aperine clivers or goose-grass. The former has a firm, erect, brown, square, stem; the leaves generally eight in each whorl, linear, pointed, brittle, and often reflex; branches short, generally two from each joint, terminating in spikes of small yellow flowers. It grows commonly in dry ground and on road-sides. The flowers will coagulate boiling milk; and the best Cheshire cheese is said to be prepared with them.

GALL, in the animal œconomy, the same with bile. See PHYSIOLOGY.

GALL-*bladder*, called vesicula, and cystis fellea, is usually of the shape of a pear, and of the size of a small hen's egg. It is situated in the concave side of the liver, and lies upon the colon, part of which it tinges with its own colour. It is composed of four membranes, or coats: the common coat; a vesicular one; a muscular one, consisting of straight, oblique, and transverse fibres; and a nervous one, of a wrinkled or reticulated surface within, and furnished with an unctuous liquor.

The use of the gall-bladder is to collect the bile, first secreted in the liver, and mixing with its own peculiar produce, to perfect it farther, to retain it together a certain time, and then to expel it.

GALL, in natural history, denotes any protuberance or tumour produced by the puncture of the insects on plants and trees of different kinds. Galls are of various forms and sizes, and no less different with regard to their internal structure. Some have only one cavity, and others a number of small cells communicating with each other. Some of them are as hard as the wood of the tree they grow on, whilst others are soft and spungy; the first being termed gall-nuts, and the latter berry-galls, or apple-galls.

GALLATES, are salts formed by the gallic acid with alkaline earths, or with metallic bases.

GALLEON, in naval affairs, a sort of ships employed by Spain in the commerce of the West Indies. The Spaniards sent annually two fleets; the one for Mexico, which they called the flota; and the other for Peru, which they called the galleons

GALLERY, in fortification, a covered walk, across the ditch of a town, made of strong beams, covered over head with planks, and loaded with earth; sometimes it is covered with raw hides to defend it from the artificial fires of the besieged.

GALLERY *of a mine,* is a narrow passage, or branch of a mine carried on under-ground to a work designed to be blown up.

GALLERY, in a ship, that beautiful frame, which is made in the form of a balcony, at the stern of a ship without board into which there is a passage out of the admiral's or captain's cabin, and is for the ornament of the ship.

GALLEY, in naval affairs, a low-built vessel using both sails and oars, and commonly carrying only a main-mast and foremast, to be struck or lowered at pleasure.

GALLIC *acid.* This acid is found in different vegetable substances possessing astringent properties, but most abundantly in the excrescences termed galls or nut-galls, whence it derives its name. It may be obtained by macerating galls in water, filtering, and suffering the liquor to stand exposed to the air. It will grow mouldy, be covered with a thick glutinous pellicle, abundance of glutinous flocks will fall down, and, in the course of two or three months, the sides of the vessel will appear covered with small yellowish crystals, abundance of which will likewise be found on the under surface of the supernatant pellicle These crystals may be purified by solution in alcohol, and evaporation to dryness. Or muriate of tin may be added to the infusion of galls, till no more precipitate falls down; the excess of oxide of tin remaining in the solution, may then be precipitated by sulphuretted hydrogen gas, and the liquor will yield crystals of gallic acid by evaporation.

A more simple process, however, is that of M. Fiedler. Boil an ounce of powdered galls in sixteen ounces of water to eight, and strain. Dissolve two ounces of alum in water, precipitate the alumina by carbonate of potash; and after edulcorating it completely by repeated ablutions, add it to the decoction, frequently stirring the mixture with a glass rod. The next day filter the mixture; wash the precipitate with warm water, till this will no longer

blacken sulphate of iron; mix the washings with the filtered liquor, evaporate, and the gallic acid will be obtained in fine needled crystals.

The gallic acid is of extensive use in the art of dyeing, as it constitutes one of the principal ingredients in all the shades of black, and is employed to fix or improve several other colours. It is well known as an ingredient in ink.

GALLINÆ, in ornithology, the fifth order of birds. Under this order are comprehended the peacock, pheasant, turkey, the common dunghill cock, partridge, grous, dodo, curissoa, &c

GALLON, a measure of capacity both for dry and liquid articles, containing four quarts; but these quarts, and consequently the gallon itself, are different, according to the quality of the thing measured; for instance, the wine gallon contains 231 cubic inches, and holds eight pounds five ounces and two-thirds avoirdupois, of pure water: the beer and ale gallon contains 282 solid inches, and holds ten pounds three ounces and a quarter avoirdupois, of water: and the gallon for corn, meal, &c. two hundred and sixty eight cubic inches and four fifths, and holds nine pounds eleven ounces and a half of pure water.

GALOPINA, a genus of the tetandria digynia class and order. Cal. none; cor. fourcleft; seeds two, naked. A plant of the Cape.

GALVANISM, or *electro-chemistry*, is the name given to a species of electricity produced by connecting dissimilar metals, by means of an intervening and oxidating fluid. It is termed Galvanism from the circumstance of its having been first observed by Galvani, professor of anatomy at Bologna. This philosopher was fortunate enough to make some observations on the electricity of the muscles of frogs, that to him appeared to depend on a new power in the animal body; and although some of the conclusions which he drew from the discovery are now admitted to be erroneous, yet they led to a train of experiments which have immortalized his name, by connecting it with some of the most brilliant discoveries of modern science.

This grand discovery was made by Galvani in the year 1789, since which time it has employed the attention of several eminent philosophers; but those who have most eminently distinguished themselves on the subject are Valli, Volta, Monro, Fowler, Davy, and Wollaston. Electricity, as produced by friction, has hitherto been but of very limited application in any of the useful arts; but the agency of the Galvanic apparatus has totally changed the face of chemistry, and promises a speedy developement of the hitherto mysterious nature of magnetism.

Many curious and interesting facts resulted from the researches of the above mentioned philosophers; but they are by far too numerous to detail in this place; the most important facts which they establish, may be reduced to the following heads:

First, That the passage of a small quantity of electricity through the nerves of any animal, occasions a tremulous motion or contraction of the contiguous muscles, and sometimes an extension of the limbs. This effect takes place both in living animals, and in such as have been recently killed, and even in detached limbs of these last. The effect is shewn to the greatest advantage on cold-blooded animals, as frogs and fishes, which retain the power of action after death much longer than others.

Secondly, The same effects that are produced by the passage of electricity, also result from the contact of different metals with the nerves and muscles; and the effects are always most considerable when the metals are most essentially different; thus zinc and gold, or zinc and silver, form a very active combination.

Thirdly, By the same means that muscular motion is excited in these trials, some of the senses are remarkably affected, as appears when the experiment is made on living animals.

The following simple and easily performed experiments will demonstrate these facts.

Take a live frog, and paste a piece of tinfoil on its back, and place it on a plate of zinc; form a communication by means of a fine clean copper wire between the zinc and the tinfoil, and spasmodic convulsions will be immediately produced.

Or procure a small flounder; place it in a dish upon a slip of zinc, and lay a shilling, or other silver coin upon its back; then, as in the former case, connect the zinc and silver, and strong muscular contractions will be the result.

The human body, whilst undergoing certain chirurgical operations, or its amputated limbs have been convulsed by the application of metals. But the living animal body may be rendered sensible of the action of metallic application in a harmless way, and both the senses of taste and sight may be affected by it, but in different degrees according to the various constitutions of individuals.

Let a man lay a piece of zinc upon his tongue, and a piece of some other metal, as silver, under the tongue; on forming the communication between these two metals, either by bringing their outer edges in contact, or by the interposition of some other piece of metal, he will perceive a peculiar sensation, accompanied with a sort of cool and subacid taste. The sensation seems to be more distinct when the metals are of the usual temperature of the tongue. The siver or gold may be applied to any other part of the mouth, to the nostrils, to the ear, or to other sensible parts of the body, while the zinc is applied to the tongue; and on making the communication between the two metals, the taste will be perceived upon the tongue. The effect is more remarkable when the zinc touches the tongue in a small part, and the silver in a great portion of its surface. Instead of the tongue, the two metals may also be placed in contact with the roof of the mouth, as far back as possible; and on completing the communication, the irritation will be perceived.

In order to affect the sense of sight by means of metals, let a man in a dark place put a slip of tin-foil upon the bulb of one of his eyes, and a piece of silver in his mouth. On completing the communication between the spoon and the tin-foil, a faint flash of white light will appear. This experiment may be performed in a more convenient manner, by placing a piece of zinc between the upper lip and the gums, as high up as possible, and a silver piece of money

upon the tongue; or else by putting a piece of silver high up in one of the nostrils, and a piece of zinc in contact with the upper part of the tongue; for in either case the flash of light will appear whenever the two metals are made to communicate, either by the immediate contact of their edges, or by the interposition of other good conductors.

It has been long asserted, that when porter is drank out of a pewter pot, it has a taste different from what it has when drank out of glass or earthenware.

It has been observed, that pure mercury retains its metallic splendour during a long time; but its amalgam with any other metal is soon tarnished or oxidated.

The Etruscan inscriptions, engraved upon pure lead, are preserved to this day; whereas some medals of lead and tin, of no great antiquity, are much corroded. Works of metal, whose parts are soldered together by the interposition of other metals, soon tarnish about the places where the different metals are joined.

When the copper sheeting of ships is fastened on by means of iron nails, those nails, but particularly the copper, are readily corroded about the place of contact.

An account of the recent discoveries and experiments of Sir Humphrey Davy, which relate to this subject, will be found under the article **SHEATHING**.

Since Galvani's discoveries, the action arising from the combination of three conductors has been examined with great care, and with considerable success, especially by Mr. Volta, who discovered that the slight effect of such a combination may be increased to a prodigious degree by repeating the combination; for instance, if a combination of silver, zinc, and water, produce a certain effect, a second combination of another piece of silver, another piece of zinc, and another quantity of water added to the first, will increase the effect; the addition of a third combination will increase the effect still more.

The apparatus now in use for Galvanic operations, is commonly termed the Voltaic battery. This instrument is variously constructed; the powers of the original construction were found to be extremely limited, and the use of it is now almost entirely abandoned. On this account we shall here do little more than refer the reader to the engravings of some of the earliest methods of fitting up the Galvanic battery. The simplest form of this instrument is that to which Volta gave the name of "*corronne des tasses.*"

It consists of a row of wine, or other glasses, containing salt and water, or any saline fluid. Into each of these one end of a metallic ore, consisting of a plate of zinc connected by a wire with a plate of copper, is plunged. These ores are so arranged, that the copper extremity of the first is in the same glass with the zinc extremity of the second, the copper of the second with the zinc of the third, and so on in regular order, as exhibited in fig. 1, Plate XVII.

This method, as may be seen by inspection, was extremely incommodious, and could not be constructed on such a scale as to obtain great power. Another method, which approximates much nearer to the power of the modern battery, is represented in fig. 2. This is called the Voltaic or Galvanic pile. It consists of a number of plates of zinc and copper, either round or square, of any size, and of an equal number of pieces of cloth, of the same form, but rather smaller. These last are soaked in salt water, or very dilute muriatic acid, until they are thoroughly moistened. The pile is then thus constructed. Place a plate of copper upon the table, then on that place a plate of zinc, and on the zinc one of the moistened discs of cloth; upon this a second series of copper, zinc, and moistened cloth in the same order; proceed thus until a series of fifty or sixty repetitions have been placed one upon the other, and the pile is complete. If now the operator moisten both his hands with the saline liquid, and with a finger of one hand touch the bottom of the pile, and with a finger of the other the top or upper plate, a slight shock will be felt at every repetition of the contact. The preparation, however, of such a pile, is a very troublesome operation; and its action, even at the strongest, will never suffice for any of the more brilliant experiments in the electro-chemical science.

The most approved and the most powerful form of the battery is that represented in fig. 3. This consists of an oblong trough of dried mahogany, into which any convenient number of double plates of copper and zinc, soldered together, are united in regular order. The intervening cells are nearly filled with the acid solution, and the action produced by connecting the two ends of the arrangement together by clean copper wires.

For the purpose of insulation, the connecting wires are generally passed through two small glass tubes of about six inches long, and which are to be held in the hands of the operator: these are seen in the figure. The ends of these wires that enter the trough, may be made fast by passing them tightly through a small piece of wood firmly fixed into the extreme cells of the trough. The substance to be operated on should be placed upon a plate of strong glass.

In fig. 4, is represented the method generally used for connecting a number of these troughs together when great intensity of action is required: the connection is formed by a slip of copper passing from the last cell of one trough into the first of that which is placed next to it.

In fig. 5, is represented another method of fitting up the trough. Here the trough A is made of earthen ware, having partitions of the same material, and the metallic plates are attached by screws and nuts to a bar of wood, so that they may be immersed and removed at one operation. The troughs are filled with dilute acid, and by uniting them in regular order, the apparatus may be enlarged to any required extent. On this principle, the great apparatus of the Royal Institution is constructed. An important improvement has been suggested in the construction of the Voltaic apparatus by Dr. Wollaston, by which great increase of quantity is obtained without inconvenient augmentation of the size of the plates. This improvement consists in extending the copper plate so as to oppose it to every surface of the zinc, as represented in fig. 6. A is the rod of wood to which the plates are screwed in the usual manner. B B the zinc plates connected as usual with the copper plates C C, which are

doubled over the zinc plates, and opposed to them on both sides, any contact of the surfaces being prevented by pieces of cork or wood placed at D D. Dr. Wollaston, with a single pair of plates constructed on this principle, succeeded in fusing and igniting a fine platinum wire. This is allowed to be the most economical and useful form in which the Voltaic apparatus has yet been constructed.

The reader will now perceive that he may construct his apparatus of any size that is best suited to the nature of the experiments which he has occasion to make. With a trough containing ten pairs of four inch plates, fitted up on the principle last explained, he may safely proceed with the more common experiments; but if he wish great intensity of action, he should never have fewer than from 150 to 200 pairs of such plates in the best possible state of action.

Experience is the best guide with respect to the preparation of the fluid with which the troughs are to be filled; but, in general, from one part of muriatic acid and sixteen parts of water, to one of acid and twenty of water, are found to be the most convenient proportions. The acid and water should be mixed in any large earthenware vessel, and well stirred with a glass rod before the compound is poured into the trough; the cells should be filled to within a quarter of an inch of the top, and the upper edges of the plates wiped perfectly dry with a cloth. It may be necessary to observe that the action is always strongest at the first; in which case the operator should study to apply it in the first instance to those experiments which require the greatest intensity of the Voltaic power.

The most extraordinary phenomena of a Galvanic battery are the chemical effects and the modifications which are produced by it upon the bodies concerned, or upon such as are placed in the circuit. We shall here describe the simplest mode of exhibiting the principal of those phenomena, namely, the evolution of gas from water, from which the mode of conducting similar experiments is easily derived.

A B, fig 7, exhibits a glass tube full of distilled water, and having a cork at each extremity. E F is a brass or copper wire, which proceeds from one extremity of a Galvanic battery, and passing through the cork A, projects within the tube. H G is a similar wire, which proceeds from the other extremity of the battery, and comes with its extremity G within the distance of about an inch or two from the wire F.

In this situation of things, it will be found that bubbles of gas proceed in a constant stream from the surface G of the wire which proceeds from the negative end of the battery; these bubbles of gas, ascending to the upper part of the tube, accumulate by degrees. This gass is the hydrogen, and may be inflamed. At the same time the other wire F deposits a stream of oxide in the form of a cloud, which accumulates in a greenish form in the water, or on the sides of the tube, and is a perfect oxide of the brass. The wire F is discoloured and corroded. If you interrupt the circuit, the production of gas and of oxide ceases immediately. Complete the circuit, and the production of gas re appears.

This production of gas may be observed even where the battery consists of not more than six or eight repetitions of silver, zinc, and water In short, if the power of the battery be sufficient to oxidate one of the wires of communication, the other wire will afford hydrogen gas; both extremities of the wires being in water.

In this experiment it seems, that hydrogen is separated from the water, and is converted into a gaseous state by the wire connected with the negative extremity of the battery: whilst the oxygen unites with, and oxidates the wire connected with the positive end of the battery. If you connect the positive end of the battery with the lower wire of the tube, and the negative with the upper, then the hydrogen proceeds from the upper wire, and the lower wire is oxidated.

If two wires of gold or platinum are used, the stream of gas issues from each, the water is diminished, and the collected gas is found to be a mixture of hydrogen and oxygen. It explodes violently.

In the above described apparatus, a little hole must be made in the lower cork B, for the purpose of giving exit to the water in proportion as the gas is formed.

The deflagration of metallic leaves by the Voltaic energy affords a very pleasing and brilliant display. The best method of performing experiments of this kind is to suspend the leaves to a bent wire, proceeding from one extremity of the battery, and to bring in contact with the lower edge of them a broad metal plate, having its surface polished, and being connected with the opposite extremity. The instant the contact is effected, the deflagration will commence. Gold leaf burns with a vivid white light, tinged with blue, producing a dark brown oxide; silver leaf emits a brilliant emerald green light, and leaves an oxide of a dark grey colour.

If a fine iron wire be connected with one end of a powerful battery, and its end be brought into contact with the surface of some mercury connected with the other extremity of the battery, a vivid combustion both of the wire and the mercury results, and a very brilliant effect is produced. When a fine steel wire of moderate length is interposed in the circuit, it becomes ignited, and may be fused into balls. Small bits of phosphorus, gunpowder, &c. may be readily kindled by a battery of moderate power.

With the large apparatus at the Royal Institution the most striking effects have been produced. When pieces of pointed charcoal, connected with the opposite extremes of the battery, were brought to within the thirtieth or fortieth of an inch of each other, a bright spark was produced, and more than half the volume of charcoal was ignited to whiteness: when the points were withdrawn from each other, a constant discharge took place through the heated air, in a space equal to at least four inches, producing a most brilliant ascending arch of light, broad, and conical in form in the middle When any substance was introduced into this light, it instantly became ignited; platina melted as readily as wax in the flame of a candle; quartz, the spphire, magnesia, lime, all entered into fusion; fragments of diamond, and points of charcoal and plum bago, rapidly

disappeared, and seemed to evaporate in it, even when the connexion was made in an exhausted receiver.

When the poles or extremities of the Voltaic battery are connected by a steel wire, it becomes magnetic; and if by a platinum or other metallic wire, that wire exhibits numerous magnetic poles, which attract and repel the common magnetic needle. This was first discovered by Professor Oersted of Copenhagen. See MAGNETISM.

But by far the most important discovery hitherto made by the application of Galvanism was that of decomposing the alkalis.

The honour of this discovery belongs to Sir H. Davy. He found that a thin piece of potash, or soda, slightly moistened by exposure to the air, and placed between two conductors of platinum, proceeding from the opposite poles of the Voltaic battery, was quickly resolved into a metalline substance highly inflammable, which appeared at the negative surface, and oxygen gas, which was evolved at the positive surface. This new metal will be found described under the article CHEMISTRY. For the information of those who may feel desirous of trying this interesting experiment, it may be proper to remark, that a battery of 100 pairs of three or four inch plates will be found sufficient for the purpose. The apparatus should be excited by a weak acid mixture, of about one part of good muriatic acid to thirty parts of water. A plate of silver or platina being connected with the negative side of the battery, a thin piece of pure potash or soda must be placed upon it, and a platina or silver conductor proceeding from the positive side of the battery, is then to be brought in contact with the upper surface of the alkali, which soon fuses at the points of contact; metallic globules soon appear near the negative surface, and gradually increase in size, until a crust of alkali begins to form on their surface: at this moment they must be removed by the point of a knife, and instantly plunged into naphta. This experiment requires very great care to insure success, which a trifling variation in the power of the battery, the purity of the potash, or the moisture of the atmosphere, may prevent.

Before quitting this subject we would introduce some remarks on the effect of this wonderful agent on the animal system. This, we think, cannot be rendered more intensely interesting than by subjoining the following account of some successfully conducted experiments by Dr. Ure of Glasgow, on the body of a man of the name of Clydesdale, who was executed at Glasgow for murder.

The subject of these experiments, says Dr. Ure, was a middle-sized, athletic, and extremely muscular man, about thirty years of age. He was suspended from the gallows nearly an hour, and made no convulsive struggle after he dropped; while a thief, executed along with him, was violently agitated for a considerable time. He was brought to the anatomical theatre of our university in about ten minutes after he was cut down. His face had a perfectly natural aspect, being neither livid nor tumefied; and there was no dislocation of his neck.

Dr. Jeffray, the distinguished professor of anatomy, having on the preceding day requested me to perform the Galvanic experiments, I sent to his theatre, with this view, next morning, my *minor* Voltaic battery, consisting of 270 pairs of four-inch plates, with wires of communication, and pointed metallic rods with insulating handles, for the more commodious application of the electric power. About five minutes before the police officers arrived with the body, the battery was charged with a dilute nitro-sulphuric acid, which speedily brought it into a state of intense action. The dissections were skilfully executed by Mr. Marshall, under the superintendence of the professor.

Exp. 1. A large incision was made into the nape of the neck, close below the *occiput.* The posterior half of the *atlas vertebra* was then removed by bone forceps, when the spinal marrow was brought into view. A profuse flow of liquid blood gushed from the wound, inundating the floor. A considerable incision was at the same time made in the left hip, through the great gluteal muscle, so as to bring the sciatic nerve into sight; and a small cut was made in the heel. From neither of these did any blood flow. The pointed rod, connected with one end of the battery, was now placed in contact with the spinal marrow, while the other rod was applied to the sciatic nerve. Every muscle of the body was immediately agitated with convulsive movements, resembling a violent shuddering from cold. The left side was most powerfully convulsed at each renewal of the electric contact. On moving the second rod from the hip to the heel, the knee being previously bent, the leg was thrown out with such violence as nearly to overturn one of the assistants, who in vain attempted to prevent its extension.

Exp. 2. The left phrenic nerve was now laid bare at the outer edge of the *sternothyroideus* muscle, from three to four inches above the clavicle; the cutaneous incision having been made by the side of the sternocleido mastoideus. Since this nerve is distributed to the diaphragm, and since it communicates with the heart through the eighth pair, it was expected, by transmitting the Galvanic power along it, that the respiratory process would be renewed. Accordingly, a small incision having been made under the cartilage of the seventh rib, the point of the one insulating rod was brought into contact with the great head of the diaphragm, while the other point was applied to the phrenic nerve in the neck. This muscle, the main agent of respiration, was instantly contracted, but with less force than was expected. Satisfied, from ample experience on the living body, that more powerful effects can be produced in Galvanic excitation, by leaving the extreme communicating rods in close contact with the parts to be operated on, while the electric chain or circuit is completed by running the ends of the wires along the top of the plates in the last trough of either pole, the other wire being steadily immersed in the last cell of the opposite pole, I had immediate recourse to this method. The success of it was truly wonderful. Full, nay, laborious breathing, instantly commenced. The chest heaved, and fell; the belly was protruded, and again collapsed, with the relaxing and retiring diaphragm. This process was continued, without interruption, as long as I continued the electric discharges.

In the judgment of many scientific gentlemen who witnessed the scene, this respiratory experiment was perhaps the most striking ever made with a philosophical apparatus. Let it also be remembered, that for full half an hour before this period, the body had been well nigh drained of its blood, and the spinal marrow severely lacerated. No pulsation could be perceived meanwhile at the heart or wrist; but it may be supposed, that but for the evacuation of the blood,—the essential stimulus of that organ,—this phenomenon might also have occurred.

Exp. 3. The supra-orbital nerve was laid bare in the forehead, as it issues through the supra-ciliary *foramen*, in the eyebrow: the one conducting rod being applied to it, and the other to the heel, most extraordinary grimaces were exhibited every time that the electric discharges were made, by running the wire in my hand along the edges of the last trough, from the 220th to the 270th pair of plates: thus fifty shocks, each greater than the preceding one, were given in two seconds. Every muscle in his countenance was simultaneously thrown into fearful action; rage, horror, despair, anguish, and ghastly smiles, united their hideous expression in the murderer's face, surpassing far the wildest representations of a Fuseli or a Kean. At this period several of the spectators were forced to leave the apartment from terror or sickness, and one gentleman fainted.

Exp. 4. The last galvanic experiment consisted in transmitting the electric power from the spinal marrow to the ulnar nerve, as it passes by the internal condyle at the elbow: the fingers now moved nimbly, like those of a violin performer; an assistant, who tried to close the fist, found the hand to open forcibly, in spite of his efforts. When the one rod was applied to a slight incision in the tip of the fore-finger, the fist being previously clenched, that finger extended instantly; and from the convulsive agitation of the arm, he seemed to point to the different spectators, some of whom thought he had come to life.

About an hour was spent in these operations.

GAMBOGE, is a substance obtained from the stalagmites cambogioides, a tree that grows wild in the East Indies; from which it is had by wounding the shoots. It is brought here in large cakes, which are yellow, opaque and brittle. With water it forms a yellow turbid liquid used in painting. In alcohol it is completely dissolved. If taken internally it operates violently as a cathartic.

GAME, in general, signifies any diversion or sport that is performed with regularity, and restrained to certain rules.

Games are usually distinguished into those of address and those of hazard. To the first belong chess, tennis, billiards, wrestling, &c. and to the latter those performed with cards or dice, as back-gammon, ombre, piquet, whist, &c.

GAMES, in antiquity, were public diversions, exhibited on solemn occasions. Such, among the Greeks, were the Olympic, Pythian, Isthmian, Nemæan, &c. games; and, among the Romans, the Apollinarian, Circensian, Capitoline, &c. games.

Among the Romans, there were three sorts of games, viz. sacred, honorary, and ludicrous. The first were instituted immediately in honour of some deity or hero; of which kind were those already mentioned, together with the augustales; florales, palatini, &c. The second class were those exhibited by private persons at their own expence, to please the people; such were the combats of gladiators, the scenic games, and other amphitheatrical sports. The ludicrous games were much of the same nature with the games of exercise and hazard among us: such were the ludus trojanus, tesseræ, tali, trochus, &c.

GAME. It is a maxim of the common law, that goods of which no person can claim any property belong to the king by his prerogative. Hence those animals feræ naturæ, which come under the denomination of game, are styled in our laws his majesty's game; and that which he has he may grant to another; in consequence of which another may prescribe to have the same, within such a precinct or lordship. And hence originated the right of lords of manors or others to the game within their respective liberties.

For the preservation of these species of animals; for the recreation and amusement of persons of fortune, to whom the king, with the advice and assent of parliament, has granted the same; and to prevent persons of inferior rank from misemploying their time, certain acts of parliament have been made. The common people are not injured by these restrictions, no right being taken from them which they ever enjoyed; but privileges are granted to those who have certain qualifications therein mentioned, which before rested solely in the king.

GAMING, the art of playing or practising any game, particularly those of hazard, as cards, dice, tables, &c.

The laws of gaming are founded on the doctrine of chances.

De Moivre, in his treatise De Mensura Sortis, has computed the variety of chances in several cases that occur in gaming, the laws of which may be understood by what follows.

Suppose p the number of cases in which an event may happen, and q the number of cases wherein it may not happen, both sides have the degree of probability, which is to each other as p to q.

If two gamesters, A and B, engage on this footing, that if the cases p happen, A shall win; but if q happen, B shall win, and the stake be a; the chance of A will be $\frac{pa}{p+q}$ and that of B $\frac{qa}{p+q}$; consequently, if they sell the expectancies, they should have that for them respectively.

If A and B play with a single die, on this condition, that if A throw two or more aces at eight throws, he shall win; otherwise B shall win; what is the ratio of their chances? Since there is but one case wherein an ace may turn up, and five where it may not, let $a=1$, and $b=5$. And since there are eight throws of the die, let $n=8$; and you have $\overline{a+b}^n - b^n - nab^{n-1}$, to $b^n + nab^{n-1}$, that is, the chance of A will be to that of B, as 663991 to 10156525, or nearly as 2 to 3.

A and B are engaged at quoits, and after playing some time, A wants 4 and B 6; but B is so much the better gamester, that his chance against A upon a single throw would be as 3

to 2; what is the ratio of their chances? Since A wants 4, and B 6, the game will be ended at nine throws: therefore raise $a+b$ to the ninth power, and it will be $a^9 + 9a^8b + 36a^7b^2 + 84a^6b^3 + 126a^5b^4 + 126a^4b^5$, to $84a^3b^6 + 36a^2b^7 + 9ab^8 + b^9$. call a 3, and b 2, and you will have the ratio of chances in numbers, viz. 1759077 to 194048.

A and B play at quoits, and A can give B 2 in 3, what is the ratio of their chances at a single throw? Suppose the chances as z to 1, and raise $z+1$ to its cube, which will be $z^3 + 3z^2 + 3z + 1$ Now, since A could give B 2 out of 3, A might undertake to win three throws running; and, consequently the chances in this case will be as z^3 to $3z^2+3z+1$. Hence $z^3 = 3z^2 + 3z + 1$: or, $2z^3 = z^3 + 3z^2 + 3z + 1$. And therefore, $z\sqrt[3]{2} = z + 1$; and consequently, $z = \frac{1}{\sqrt[3]{2}-1}$ The chances, therefore, are $\frac{1}{\sqrt[3]{2}-1}$, and 1, respectively.

Suppose I have two wagers depending, in the first of which I have 3 to 2 *the best of the lay*, and in the second 7 to 4, what is the probability I win both.

1. The probability of winning the first is $\frac{3}{5}$, that is the number of chances I have to win, divided by the number of chances, the probability of winning the second is $\frac{7}{11}$; therefore, multiplying these two fractions together, the product will be $\frac{21}{55}$, which is the probability of winning both. Now, this fraction being subtracted from 1, the remainder is $\frac{34}{55}$, which is the probability I do not win both wagers: therefore the odds against me are 34 to 21.

2. If I would know what the probability is of winning the first, and losing the second, I argue thus: the probability of winning the first is $\frac{3}{5}$, the probability of losing the second is $\frac{4}{11}$: therefore multiplying $\frac{3}{5}$ by $\frac{4}{11}$ the product $\frac{12}{55}$ will be the probability of my winning the first and losing the second; which being subtracted from 1, there will remain $\frac{43}{55}$, which is the probability that I do not win the first, and at the same time lose the second

3. If I would know what the probability is of winning the second, and at the same time losing the first, I argue thus: the probability of winning the second is $\frac{7}{11}$, the probability of losing the first is $\frac{2}{5}$: therefore multiplying these two fractions together, the product $\frac{14}{55}$ is the probability I win the second and also lose the first.

4. If I would know what the probability is of losing both wagers, I say, the probability of losing the first is $\frac{2}{5}$, and the probability of losing the second $\frac{4}{11}$: therefore, the probability of losing them both is $\frac{8}{55}$, which being subtracted from 1, there remains $\frac{47}{55}$: therefore the odds of losing both wagers is 47 to 8.

This way of reasoning is applicable to the happening or failing of any events that may fall under consideration.

GAMMONING, among seamen, denotes several turns of rope taken round the bowsprit, and reeved through holes in knees of the head, for the greater security of the bowsprit.

GAMMUT, in music, the name given to the scale laid down by Guido, and to the notes of which he applied the monosyllables *ut, re, mi, fa, sol, la*. Having added a note below the lowest tone of the ancients, he adopted for its sign, the gamma, or third letter of the Greek alphabet; and hence his scale was afterwards called gammut. This gammut consisted of twenty notes, viz two octaves and a major-sixth. The first octave was distinguished by capital letters, as G, A, B, &c. the second by small letters, *g, a, b*, &c. and the supernumerary by double letters, as *gg, aa, bb*, &c. By the word gammut, we now generally understand the whole existing scale: and to learn the names and situations of its different notes is to learn the gammut.

GANG, in sea affairs, a select number of a ship's crew appointed on any particular service, and commanded by an officer suitable to the occasion.

GANG-*board* is a plank with several steps nailed to it, for the convenience of walking into, or out of a boat upon the shore, where the water is not deep enough to float the boat close to the landing place.

GANGRENE. See SURGERY.

GANTLET, or GAUNTLETT, a large kind of glove made of iron, and the fingers covered with small plates. It was formerly worn by cavaliers, when armed at all points.

GANTLOPE, in sea affair [illegible] nounced gantlet, is a race which a criminal is sentenced to run in a vessel of war for felony, or some other heinous offence. The whole ship's crew is disposed in two rows, standing face to face on both sides the deck, each person being furnished with a small twisted cord, having two or three knots in it; the delinquent is then stripped naked above the waist, and obliged to pass forward between the two rows, a certain number of times, rarely exceeding three, during which, every person is enjoined to give him stripes as he runs along: this is called "running the gantlet," and is seldom inflicted but for crimes which excite general antipathy among the seamen.

GAOL *delivery*. By the law of the land, that men might not be long detained in prison, but might receive full and speedy justice, commissions of gaol-delivery are issued out, directed to two of the judges, and the clerk of assize associate; by virtue of which commission, they have power to try every prisoner in the gaol committed for any offence whatsoever.

GARCINIA, a genus of the monogynia order, in the dodecandria class of plants, and in the natural method ranking under the 18th order, bicornes. There are three species. The mangostana is a tree of great elegance, and producing the most pleasant fruit of any yet known.

GARDENIA [illegible] genus of the pentandria monogynia class [illegible] order. There are 15 species, chiefly shrubs of the Cape and Japan. They are known in our stoves by the name of Cape jasmin and some of them are highly ornamental.

GARDENING. This art so natural to man, and so conducive to the comforts and luxuries of life, may properly be divided into two branches; practical, and picturesque or landscape gardening.

A garden, properly speaking, is a small spot of ground attached to the house. As the house is itself a regular and formal object, so we

naturally expect something of the same regularity in this appendage. Neatness too is one of the chief excellencies of a garden, and this is found to be wholly inconsistent with a rage for the picturesque.

The situation of a garden should be dry, but rather low than high, and as much sheltered as can be from the north and east winds. These points of the compass should be guarded against by high and good fences; by a wall of at least ten feet high; lower walls do not answer so well for fruit-trees. A garden should be so situated, that it may be as much warmer as possible than the general temperature of the air is without, or ought to be made warmer by the ring and subdivision fences.

The form of a garden may be a square, [illegible] it can be avoided, because crops come in [illegible] and plants do not stand the winter so well, [illegible] such a situation. A garden with a northern aspect has, however, its advantages, being cooler for some summer productions.

The soil that suits general cultivation best is a loam, rather red than black. The worst soil is a cold heavy clay, and the next a light sand; a moderate clay, however, is better than a light soil, though not so pleasant to work. If the soil is too poor, too strong, or too light, it is to be improved without delay. Let it first be broken and cleaned of all rubbish, to a regular level depth at bottom as well as at top, so as to give full eighteen inches of working mould, if the good soil will admit of it; none that is bad should be thrown up for use. This rule of bottom levelling is particularly necessary when there is clay below, as it will secretly hold up wet, which should not stand in any part of the garden. When a piece of ground is cleared it would be of advantage to have the whole thrown into two-feet wide trenches. There is this advantage of a deep staple, that in the cultivation of it the bottom may be brought to the top every other year, by double trenching; and being thus renewed, less dung will do, and sweeter vegetables be grown.

The aspect of the wall designed for the best fruits may be full south; or rather inclining to the east, by which it will catch the sun's rays at its rise, the cold night-dews be earlier dissipated, and the scorching rays of the afternoon sun are sooner off. By thus having the walls of a garden not directly to the four points, the north wall is greatly advantaged by having more sun.

The border next this wall should be of very good earth, about two feet deep, rising a little towards the wall. A free moderate loam, or some fresh maiden soil, not too light, is necessary to make the borders promising good; and in order to this, if manure is necessary, let it rather be that of rotted vegetables, or turf, with a small quantity of wood-ashes, for the roots of fruit-trees should not meet with much dung, at least of horses: that of cows is the best, or that of sheep or hogs will do well rotted, well mixed, &c. being worked in the borders as long as possible before the trees are to be planted.

If a garden is large and square, a second south wall, running down the middle of it, would be very useful, and so, if large and long, a cross wall or two might be adopted, as giving opportunity for the cultivation of more trained fruit-trees; and if there is any idea of forcing fruits, these intersecting walls, ranging east and west, are [illegible]t (as situated within the ring-fence), [illegible]d with flues, &c.

The best fruit-border [illegible] prepared for peaches, nec[illegible] apricots, or vines and figs, the trees sh[illegible] their residence there (if the leaf is [illegible] about the latter part of October, or as [illegible] as can be. If the middle of Dec[illegible] February is then the time; [illegible] plant all winter, if the weather [illegible] the time to work [illegible]; may do, or even [illegible] not be older than two [illegible] budding except in fine [illegible] early and late peaches; [illegible] cut off, and the latter not [illegible] plant should be about 12 [illegible] the wall; and let apricots, peaches, and nectarines, be twenty feet asunder, more or less, according to the height of the wall; though for the small early sorts fifteen or sixteen feet will do. As the larger apricots, however, grow freely, and do not well endure the knife, they ought to have twenty-five feet allowed them. This is for a wall of nine or ten feet high; if higher, the distance may be less, and if lower, the contrary. Fig-trees require as much room as the apricot, or rather more; as they grow freely, and are to extend without shortening. Though other trees are best planted in October, the fig should not be till March.

The intermediate spaces between peaches, nectarines, and apricots, may have a vine, a dwarf cherry, or currant or gooseberry tree of the early sorts, as the smooth green and small red, to come in early. But wherever grapes can be expected to ripen, there let a young plant, or cutting, be set, though the space should be confined; for the vine, freely as it shoots, bears the knife well to keep it within bounds. If the wall is high, the cherry or plum may be half-standards; which being after a while kept above, will be more out of the way of the principal trees: though dwarfs may be trained so as not to interfere. Some have planted half-standards of the same kind of fruit as the dwarfs; but which ever mode is adopted, let the intermediate trees be pruned away below in good time, in order to accommodate the principals freely as they mount and extend.

Plums, cherries, and pears, may occupy the other walls; the two former at about fifteen feet, or it may be twenty feet asunder. Cherries, except the murella, will not do well in a full north aspect; but any sort of plum (rather a late one) and summer pears, and also nut-trees, will, if you choose to train them. There should always be some currants and gooseberries in an east and north situation, at the distance of eight feet, where they will be easily matted, when ripe, to come in late, as October, November, or perhaps December. Pear-trees of free growth are hardly to be kept within tolerable compass on low walls; but [illegible] tempted, should have at least th[illegible] them. The best sorts of winte[illegible] a southerly wall to ripen them [illegible] prove them in size and flavour. The ga[illegible]

of a house is well adapted for a pear-tree, as it affords room, which they require. Apples may do on a wall (and if any on a good wall, let it be the golden pippin,) yet the practice is seldom adopted. For furnishing walls choose trees of moderate wood, young, well rooted, clean, and healthy.

When the planting of a garden is finished, it is a good way to have a plan of it taken, with the name of every peculiar tree marked on it in their place, to be assured of the sorts when they come to bear.

Here it may be observed, that if any evergreen hedges are desired, in or about, the garden, yew, box, alaternus, [illegible] phillyrea, and pyracantha, may be [illegible] in form, if so desired; in [illegible] a few roses were inter[illegible] fine effect. A deciduous [illegible] or screen, &c. may be made [illegible] setting the larger plants at [illegible] and a smaller one between. [illegible] fence, or sub-division, may be quickly [illegible] of elder cuttings, stuck in at two feet asunder, which may be kept cut within bounds.

A wide border next the south wall, as was said, is best for the trees; and moreover for the many uses that may be made of it for the smaller early, or late tender esculents, and a few early cauliflowers. For the sake of a pleasant warm walk in spring, to have the south border narrow may be desirable; but on no account let it be less than six feet. Take care that this walk is not sunk too much; and that it have a bottom of good earth, as deep as where the trees are planted. Let the body of gravel be thin, and then the roots of the trees will be admitted to run properly under the walk, and find wholesome nourishment; where, if they were stopped by rubbish, they would be apt to canker and disease the trees.

The number and breadth of the walks must in a measure be determined by the quantity of allotted ground; exceeding in these particulars where there is room. But few and wide walks are better than many and contracted.

If the ground is laid out in autumn, defer the making of the walks till spring, when the earth will be settled. Gravel laid towards winter would be disturbed by the frost, and the necessary work about the quarters and borders. But whenever made, the garden ought to be brought to an exact level, or slope; then the walks should be stumpt, keeping the tops of the stumps very level (as guides) to the true pitch of the quarters by a light line, made of good hemp, that will bear pulling tight. Proceed to take the earth out of the alleys about eight inches deep, which may be thrown towards the middle of the quarters, to give them a small convexity, which makes them look well.

Rake the bottom of the walk level, and lay the gravel to within two inches of the top of the stumps. The gravel will settle a little, but the walks should always be about three or four inches at their edge, below the quarters, or these will have a flat, and also a mean appearance.

If edgings are to be made, in order to separate between the earth and gravel, especially if of stone, or wood, or box, they should be done first, and they will be a good rule to lay the box by.

If you have plenty of gravel, lay it moderately fine; if little, some small stones, or rubbish of any kind, may be laid in first, and rammed down level with a broad rammer; but do not spare for a little expence, if gravel can be had, as a thick coat of fine gravel will bear relaying, or turning over, to refresh it occasionally in the spring. As the gravel is laid, let the operator neatly rake the larger parts down to the bottom, leaving a fine surface, in a small degree convex, *i. e.* just barely sufficient to throw off wet; walks that lie very high in the middle are unpleasant to both eye and feet, and cannot be so well rolled and kept in order.

When deep walks of gravel are designed, for the sake of the mould dug out of the alleys it should be foreborne, and laid thin, if any trees are intended to be planted near the edge: for if the roots of trees have not a good soil to strike into, when they reach the walks, they will not prosper. In laying gravel very thick it is a good way to do it at two courses; the first of which may be rough, as it comes from the pit, yet still raking the larger parts down and then ramming or treading it; and the last course should be all of screened materials.

It is best to lay a few yards of gravel only at a time, before ramming or treading; after which it may be necessary to go over it with a fine iron rake, tooth and back; and then a whole walk being finished, it should be repeatedly pressed with a moderately heavy roller; and again soon after the next rain that falls. Thus will the walks become nicely level and firm, in which their excellence consists.

Grass walks may answer where gravel is scarce; but the latter is in all respects preferable.

Camomile has been used also to form green or carpet walks, planting it in sets about nine or ten inches asunder; which naturally spreading the runners are fixed by walking on them, or rolling.

Sand may be adopted for walks, and there is a binding sort of it that does very well; but lay not any of it too thick, as it is the less firm for it. Drift sand is a good substitute for gravel.

Coal-ashes strewed thinly in the alleys are better than nothing, as they at least serve to keep the feet dry and clean. Sea-shells make very good walks.

All trees designed to be planted are to be thought of before winter. Those of the wall have been spoken of; and as to standards, they must have a fair depth of good soil to grow in; for it should be remembered, that tree-roots in a garden are prevented from running over the surface, as they do in an undisturbed orchard. It is necessary that some caution should be used not to dig the ground too near and too deep about garden trees lest loosening the roots they should not be able to stand the wind; and because the nearer the surface any root grows, the more and choicer fruit the tree bears.

But the fewer standard trees in a garden the better, as they take up much room, and by their shade prevent the proper growth of vegetables that are near them; so that if a garden is small, there should be no trees except those of the wall. The case is different where there is ample room; and the blossoms of fruit-trees (apples particularly) are so delightful, that if they produced nothing for the palate, there

would be a sufficient inducement to plant them for ornament; but let them be dwarf standards in preference to espaliers.

Dwarf-standards occasion less trouble to keep them in order than espaliers, and are generally more productive; for espalier trees are seldom managed well, and thus appear unsightly: at best they are stiff and formal, and obstruct the sight in viewing the quarters of a garden, which, if in order, are worthy of coming under the eye.

If espaliers are planted, let them be only fruit of the best sorts, and in spacious gardens, where they may have a good length and height allowed them to grow freely.

Espalier trees should rather be trained to sawed materials properly framed together, smoothed, and painted. But for a year or two they may be fastened to light stakes, when they will have formed a head, to begin to train them for bearing in the neat manner proposed, that is, to slips of deal joined to light oak posts, as trellises. Whether the slips are placed perpendicularly, or longitudinally, seems indifferent. If the longitudinal mode of training be approved, strong iron wire may be recommended to run through the posts instead of slips of wood, as it shades less, and is stronger and neater. If upright slips are used, they should be slender, and from six to eight inches distance, according to the greater or less freedom of the natural growth of the tree.

Apples should be allowed 24 feet, and pears 30; except those grafted on paradise or quince stocks, for which little more than half this distance may answer. Cherries and plums should have about 18 or 20 feet allowed them. Quinces, medlars, mulberries, and filberts, may also be espaliered. The trees should be planted about a yard from the edge, but farther off is better, if the walks lie deep of gravel or poor materials.

Currants, gooseberries, and raspberries, do well espaliered, as to a production of early and fine fruit.

Trees of a more humble nature, and shrubs, next occupy attention in furnishing a garden. Currants and gooseberries (as bushes) should be planted three feet from the edge, and fully six feet asunder. Some of these very useful shrubs should grow in every aspect of the garden, in order to have a succession of their fruits as long as may be. Those who choose to plant whole quarters of currants and gooseberries ought to do it at six feet asunder in the rows, and the rows eight feet from one another.

Raspberries may be set in plantations, in rows, five feet asunder, allowing three feet between the plants. These shrubs are always best by themselves, as otherwise their suckers over-run the quarters. Between rows of raspberries planted at the above distance, coleworts, early cabbages, cauliflowers, and lettuces, may be set, or spinach sowed in drills; the raspberries having had their pruning and dressing early in autumn, for the purpose. Every year a little short manure, dug in close about the roots, (and deeper as the plantation gets older) will insure fine fruit. Raspberries are not very nice as to soil and situation. The smooth-wooded, or cane rasp, is to be preferred for a principal crop. The large, white, or Antwerp, is also good.

Strawberries may be planted at the edges of borders and quarters, either in single or double rows (rather the latter) for the convenience of gathering, and for ornament; but the common and best way is, in four-feet beds, with eighteen-inch or two-feet alleys, on which beds may be five rows of the wood and alpine, four of the scarlet and pine-apple, three of the Carolina, and two of the Chili; setting the plants at the same distance in the rows, as the rows are from one another in what is called the quincunx order. In a good, cool, loamy soil, which suits them best, a little more distance may be allowed the first four sorts; and in a quite dry light soil, somewhat less, that they may shade one another the better from drought.

The best situation for strawberries is an open and sunny one, as thus they bear more, and finer-flavoured fruit. Some of the scarlets should be planted under warm walls to come early. The woods bear shade as natural to them, and the alpines do tolerably well in it.

The most proper time for planting the strawberry is the first moist weather in September, (or even earlier) that they may be established in the ground before winter, and they will bear the better the first year. Frost is apt to throw up late-planted ones, and injures, if not destroys them. Those planted in spring often suffer from drought, and bear very little the first year, except the alpines. Choose forward runners for planting, and let them be from beds in full bearing, that is, of two or three years old: for plants from old beds are not so fruitful. Press the mould to the roots, give them a watering, and again once or twice, if the weather proves dry. Some gardeners let them run over the beds, which in a dry light soil may be proper; but in this case, a greater distance should be allowed them at planting.

If the alpine sort is planted on a warm border, 18 inches asunder, and suffered to spread, the first runners will fruit the same year, and sometimes this prolific strawberry bears till November.

Fresh plantations of strawberries should be made every fourth year, though in a good soil and with good management they will continue longer: so that where they are suffered to run, the plants being frequently renewed, and old ones removed, beds have borne tolerably for ten years.

The watering of strawberries should not be neglected, doing it almost daily when in flower, and setting their fruit, if the weather proves dry, particularly to those under a warm wall; but this is not to be continued when the fruit is nearly ripe.

Flowering shrubs may be dispersed about, and herbaceous perennial flowers; but plant them not too near the edge, lest they hang over the walks. The bulbous sorts may, however, be within six inches, especially crocusses and snowdrops.

Asparagus and artichokes take up much room, and in small gardens should be left out. It will be of little use to have less than 50 or 60 feet of asparagus beds, as there would be so few heads to cut at a time; and artichokes must be planted wide, or they will not grow large and fleshy, in which their merit consists.

Let not pot-herbs be forgotten, but provide a general herbary in that part of the garden which is warmest, and best shaded, for these are tender plants.

Having spoken of stationary things, the routine of the seasons must dictate the rest; and the inclinations of [illegible] will refresh the memory to take [illegible] providing the most necessary and [illegible] lents for dressing, [illegible] raw salad [illegible] mentioned; but [illegible] and biennials [illegible] conveniently [illegible] be, as much as [illegible] mented.

[illegible] ng a garden with shrubs and [illegible] spect should be had to their usual [illegible] ir bulk, colour, and season, that the [illegible] may be properly varied, harmonious to the eye, and come in regular succession. The latter part of the year is seldom provided for so well as it might be; late flowers should be set in warm situations, as their proper place. In the most dreary months, by judicious planting, evergreens in their neat and cheerful "winter liveries," may be viewed from our windows, and serve instead of flowers.

Those who ga[illegible] a large scale, should take care to h[illegible] ng proper and convenient liber[illegible]. Let there be a [illegible] hot-beds, with some [illegible] and (if dry) for keeping [illegible] eds and herbs. Those also who [illegible] upon a small scale will do well to [illegible] needful implement.

If water can be introduced, and kept clean with verdant banks around it, it would be found very useful where a garden is large; but let it be as near the centre as possible, as the most convenient situation. It should be fed from a pond in preference to a spring.

Mixed gardening, as comprehending the useful with the sweet, the profitable with the pleasant, has been the subject hitherto; but if the flower garden and the kitchen garden are to be distinct, the case is altered; not so much indeed but that still the kitchen garden should be adorned with a sprinkling of the more ordinary decorations, to skirt the quarters, chiefly those of the most powerful sweet scents, as roses, sweet-briars, and honey-suckles, wall-flowers, stocks, pinks, minionet, &c. in order to counteract the coarser effluvia of vegetables, or of dead leaves, which, however, should not be suffered to annoy.

The flower garden, properly so called, should be rather small than large; and if a separate portion of ground is appropriated for this, only the choicest flowers should be introduced, and no trouble spared to cultivate them in the best manner. The beds of this garden should be narrow, and consequently the walks numerous; and not more than one-half or two-thirds the width of the beds, except one principal walk, all round, which may be a little wider. The gravel, or whatever the walks are made of, should lie about four inches below the edge. The beds for tulips, hyacinths, anemonies, ranunculuses, &c. may be three and a half or four feet wide, and those for single flowers the same, or only two and a half feet wide in the borders. Let the beds lie rather rounded in the middle, but the walks flat.

Figured parterres are now out of fashion, as a taste for open and extensive gardening has prevailed; but when the beds are not too fanciful, but regular in their shapes, and chiefly at right angles, after the Chinese manner, an assemblage of all sorts of flowers, in a fancy spot of about sixty feet square, is a delightful home source of pleasure, worthy of [illegible]. There should be neat edgings of box to [illegible] beds, or rather of neat inch-boards, painted lead colour, to keep up the mould. Be sure to keep the box from the very first, as soon as rooted, and always after, as low as possible: clip it twice a year, April and July.

Landscape, or *picturesque gardening*, is so much the work of fancy, and so much depends upon the situation, or what the celebrated Mr. Brown used to call the capability of the place, that no precise rules can be laid down concerning it. All, therefore, that can be expected, is a few loose hints, on which the man of taste may improve according to circumstances.

The pleasure we seek in laying out gardens, is now justly founded upon the principles of concealed art, which appears like nature; but still, whether ingenious contrivances, and decorations, (altogether artificial,) should be so entirely laid aside as they are, may deserve to be considered. Gardens were formerly loaded with statues, and great improprieties were committed in placing them, as Neptune in a grove, and Vulcan at a fountain, large figures in small gardens, and small in large, &c. but perhaps the works of the statuary might still be introduced if well executed, and in proper places. A terrace, as a boundary, is now seldom formed; but in some situations, such an eminence might in several respects be agreeable.

If trees are planted injudiciously, the error is a trifle; but if cut down so, the consequence is serious, and has often been sorely lamented; extirpation should therefore be well thought of before it is executed; especially trees about houses, for many dwellings have been thus too hastily exposed, and deprived of comfortable shelter and shade.

Hilly spots that are in view of the house should be planted with firs, as fine-looking trees, and very hardy. Beech does well on high ground, especially if chalky. In low ground, not to mention alders, and that tribe, the birch, and even the oak, should not be forgotten, where the wet does not long stand.

About the house some shady walks ought always to be provided, by thick planting, if not of trees, yet of flowering shrubs, and evergreens, of which the laurel will be found the most useful.

Those who have much space of ground to decorate, do well to plant trees and shrubs of every kind, as enlarging the *sources* of amusement, and affording [illegible] nities for observation; but if the [illegible] of ground for this purpose is con[illegible], of course, those only should be [illegible] which by their neat foliage, natural [illegible] gay flowers, may be truly estee[illegible].

The walks should [illegible] wide, some inclining to serpen[illegible] as much as possible upon a level. That they may be extensive, they should skirt the grounds, and seldom go across them. In small pleasure-grounds the edges of the walks should be regularly planted with flowers, and long ones occasionally so, or with the most dwarf shrubs; and neat sheltered compartments of flowers, (every now and then to be met with) have a

good effect. If the walks are extended to distant plantations of forest-trees, every opportunity should be taken to introduce something of the herbaceous flowery kind, which will prove the more pleasing, as found in unexpected situations. The outer walks of pleasure-grounds and plantations should every now and then break into open views of the country, and to parts of the internal space, made pleasing, if not striking, by some work of art, or decoration of nature.

Water should only be introduced where it will run itself clear, or may be easily kept so, as also in full sight; and some fall of it should be contrived, (if possible) for the sake of giving it motion and sound, because a lively scene of this element is always much more pleasant than a dead one. Near some pieces of water, as a cool retreat, it is desirable that there should be something of the summer-house kind, as a simple rustic arbour, embowered with the woodbine, sweetbriar, the jessamine, and the rose.

Before the design of a rural and extensive garden is put in execution, it ought to be considered, or anticipated, what it will be in twenty or thirty years time; for it often happens, that a design which looks handsome when first planted, and in good proportion, becomes so small and ridiculous in process of time, that there is a necessity either to alter it, or destroy it entirely, and so plant it anew.

Landscape gardening depends much on the form of the ground, and therefore to shape that is the first object.

Too much plane is to be guarded against; and when it abounds, the eye should be relieved by clumps, or some other agreeable object. Hollows are not easily filled; and eminences mostly are advantageous, in the formation of picturesque scenes, in which the general principle of ornamental gardening consists.

To plant picturesquely, a knowledge of the characteristic differences of trees and shrubs, is evidently a principal qualification.

To range the shrubs and small trees, so that they mutually set off the beauties, and conceal the blemishes of each other; to aim at no effects which depend on a nicety for their success, and which the soil, the exposure, or the season of the day, may destroy; to attend more to the groupes than to the individuals; and to consider the whole as a plantation, not as a collection of plants; are the best general rules which can be given concerning them.

The cultivation of a garden.—The first object with a view to produce should be, to keep the ground in such a state as will enable it to produce good crops. Good vegetables cannot be had without good manure. Yet raw unwrought dung is not good for a garden. The most economical plan therefore, that can be pursued, is for the first year to make good hot-beds of manure, and spread it out upon the quarters, and dig it in autumn and winter. You by this means have a double produce, and the manure is the better.

Dung, however, used in great quantities, and lying in lumps, breeds worms, grubs, and other insects, and causes plants to grow rank-flavoured. Carrots it cankers, and it disagrees with many things. On these accounts some persons have been induced to dress their gardens only with rich fresh earth; which, if they do not overcrop, will do very well.

In the occupation of ground, the change of crops will be proper, as each sort of plant draws a somewhat different nourishment: so that after a full crop of one thing, one of another kind may often be immediately sown; but it should be contrived that a wide crop may follow a close one, and contrariwise.

Close crops, as onions, leeks, carrots, &c. are conveniently and neatly cultivated in beds of from four to five feet width, with alleys of from a foot to eighteen inches between them.

The seasons proper for furnishing the ground with every particular vegetable, should be well attended to, that each may be obtained as early as its nature will permit; and of the seeds and plants used, care must be taken to procure the best of the kind, lest after all the trouble of cultivation, disappointment as to quality should ensue.

Seeds and plants should be adapted, as much as possible, to the soil and situation which best suits them.

The thinning of seedling corps should be done in time, before the young plants have drawn one another up too much. All plants grow stronger, and ripen better, when the air circulates freely round them, and the sun is not prevented from an immediate influence.

Shading of newly-planted things, particularly flowers, is of much benefit, and that in proportion as the season is sunny.

Strawberries and cauliflowers are generally watered in a dry season: that is, the strawberries, when in bloom, in order to set the fruit, and the cauliflowers, when they shew fruit, in order to swell the head. In a light soil, this ought particularly to be done. In very dry weather, asparagus seedlings, early turnips, carrots, radishes, and small salads, will need watering. Slips, cuttings, and layers of any kind, will need water. Pots of flowers must have it frequently.

When watering is undertaken, let it be a complete business; i. e. to the bottom and extent of the roots, as much as may be. The wetting only the surface of the ground is of little use, and in some cases proves detrimental.

Watering the roots of wall-trees, (if dry weather) when the fruit is setting, is by some thought necessary. To young trees only it can however be of use, for the roots of old ones run far and wide; and it is the small fibres of these distant roots, on which the tree chiefly depends for food. Vines should have no water till they are off blossom, (July) and the fruit as big as large pins' heads; and then if the season is very hot and dry, watering the roots twice a week will help the fruit to swell.

As watering is apt to make ground hide-bound and unsightly, let the surface be occasionally stirred and raked, which will make future waterings enter the ground the better.

The quality of water used for refreshing plants is a material thing. Rain water is by far the best, as appears by the verdure and vivacity it gives.

Pond water is next in fitness, and river water follows. Well water is of least account, though local circumstances occasion its use, the

moist. Pump-water, if used directly, is so cold in summer, that it is found prejudicial to plants: and great cold so contracts their vessels, that they perform their proper offices with difficulty, and become diseased.

The management of a garden, as somewhat distinct from the cultivation of it, is an object of consequence; that is, to keep it in such order, that it may not fail in those general impressions of pleasure it is capable of affording, when things are shewn in their best manner. A garden may be cultivated so as to be profitable; and yet not conducted so as to be agreeable to walk in, which in a private garden is a circumstance to be lamented. The proper appearance of a well managed one is expressed by the word neat. Let all be done that can be in order to it.

To be neat, weeding must be industriously followed up, and all litter that is made in working, quickly carried off. The ground also should be frequently stirred and raked between crops, and about the borders, to give all a fresh appearance. There is a pleasantness to the eye in new broken earth: and when there are no flowers left in the borders, this gives an air of culture, and is always agreeable. An asparagus-fork is expeditious and useful in this case: but it must be slightly used, lest it disturb the roots of plants too much. Vegetables should not be suffered to rock themselves by wind, so as to form holes round their stems, but be well earthed up or otherwise supported.

Trees and shrubs should be constantly freed from suckers and dangling shoots, and wall trees ought to be regularly kept in order. Grass-plats and walks should have their edges occasionally cut, and be mowed as often as there is the least hold for the scythe, for they lose much of their beauty, when the grass gets long; leaves should not be suffered to remain on them, as it stains the grass, and worm-casts should be cleared away. Edgings of all sorts should be kept in good order, as having a singularly neat effect in the appearance of a garden.

Some fruits may need support, by tying their weak branches, when they get heavy, to stakes, &c. Rows of raspberries and beans are kept neatly up in their lines, by putting in here and there a stake, and using pack-thread lengthwise; and thus will they bear better, and be more conveniently gathered. Strawberries of fine heavy sorts, will be preserved from getting dirty and rotten, by tying their stems to little sticks: by this practice the fruit also gets better ripened, and of a finer flavour. Some persons lay tiles, or moss round the plants, when the fruit is half grown; but this is not, generally, so well, only it has the advantage in keeping the ground cooler in a hot season. The first and finest scarlets best deserve this trouble.

Flowers should be frequently tied up, and dead and dangling parts trimmed off. Some of them cannot do without support; and many sorts are made more secure and beautiful by proper ties.

The sticks used for flowers, should be of smooth wood, as neat painted slips of deal, with or without an ornamental head; white is the best colour, on account of its contrast with the leaves. Decaying flowers should be timely trimmed or removed, and perennials should be regulary freed from the parts running to seed, (except so much as may be wanted) as the production of seeds weakens the root much.

Of Propagation.—Plants are propagated by seeds, suckers, slips, off-sets, divisions, cuttings, layers, and grafts.

By seed is the most general method of propagation, and plants raised any other way are seldom so fine. Those plants from seed which have never been removed, are commonly handsomer, and come forwarder, than those that have been transplanted, provided they were sown in a proper soil and situation.

Commonly speaking, new seed is to be preferred to old, as growing the more luxuriantly, and coming up the surer and quicker.

If old seed is knowingly sown, some allowance in point of time must be made. Peas and beans of two years old, are by some preferred to new, as not running so much to straw.

As to the age of seeds, at which they may be sown and germinate, it is uncertain, and very much depends on how they are preserved.

Seeds should be saved from fine forward plants, secured from rocking about when they get tall; guard them against birds, gather them regularly as they ripen, and keep them dry: curious flower-seeds are kept well in phials: others in small drawers, and some may be hung up, or kept on shelves in their pods.

Seeds may be forwarded for sowing by various ways of procuring a germination before they are put into the ground. In summer it has been usual to steep both broad and kidney beans in soft water, about twenty-four hours, to forward their growth, and to ascertain their vitality.

The smaller seeds, as carrots, &c. may be prepared for sowing, by simply mixing them in a little moist sand, or fine earth, taking care that they do not lie longer than the usual time of their beginning to sprout.

The season for committing seeds to the ground, should be as early as the nature of the plant to be cultivated will bear; for the forward productions which come without forcing are the best as to size, flavour, and fruitfulness, if they meet with no material check from weather.

Let this direction for early sowing be understood, not only of spring, but autumn crops; that the plants designed for winter use, or to stand for spring, may be [illegible] and well established in the ground: t[illegible] for those designed for spring, it is advisable to have two or three different sowings.

To be sure of a crop, and in some things a succession of crops, various sowings should be made through the year, at all times that are not too unnatural as to season; for it is an object in gardening, not only to have early and late productions, but never to be without what may be produced.

Sowings should be generally performed on fresh dug or stirred ground. The digging should therefore be done as near the time designed to sow as can be. If the ground turns up raw, or

wet as early in the spring it is apt to do, a little time must be allowed it to dry, and so also, if rain falls first.

The proper depth at which seeds should be sown is to be carefully observed; if too deep, they will either rot, or not thrive well; and if too shallow, they are liable to be injuriously affected by frost, wind, drought, or birds: but of the two rather too shallow, than too deep, is best.

The smaller the seed the finer should the soil be, and the less also the covering; so that while some, as the seed of celery, is to be but barely covered, others, as pease and beans, may have a depth of two, three, or four inches. But some regard is to be had to the season and soil; in a warm season, and light soil, sow deeper, and the contrary shallower.

The quantity of seed sown is a thing to be attended to with some exactness. Small seeds go a great way, and require a careful hand to distribute them; for though sowing a little too much is a trifle as to the value of seeds, yet to have them come up crowding thick is an evil.

It is not generally advisable to sow several sorts of seed on the same spot, as some persons are accustomed to do.

Some little things of this sort, indeed, may be done; as a piece of ground newly planted with horse-radish may be top-cropped with radishes, or spinach, &c. A thin crop of onions upon new asparagus-beds, may also take place, drawing them while young from about the plants.

All seeds come up best when moderately pressed with the earth; for if they lie too lightly in contact with it, cold and drought more easily affect them; and when once seeds begin to germinate, they are impatient of both. To trample seeds is, on the whole, better than any other pressure. This done, lay all immediately and neatly level with a wide rake, drawing off stones, &c. but do it lightly, to avoid driving the teeth of the rake, which would remove the seed, and make it come up irregularly.

Propagation by suckers is a mode of culture rather peculiar to trees and shrubs. The things to be observed in this business are, to take them up with some care from the mother plant, so as not to injure its root, nor the sucker's own root, by pulling it up without properly loosening it first. The earth should be moved aside by a trowel, and then the sucker cut off by a knife, and not with a spade. Wherever a root appears barked, the part below should be cut off. If it is desired to succeed well, in propagating by suckers, consider that all young roots are tender: let them be trimmed to form, and planted immediately. Suckers with poor roots, must have their heads reduced the more.

Propagation by slips is of two sorts, either from the root or stem. When from the roots, if the whole is not taken up, move the earth carefully aside, and slip it off by a pressure of the thumb and finger, and be cautious of hurting the fibres of the slips, planting with fine and good mould about them. Take off slips from the stem carefully by the push of the thumb, and not too many from the same plant, as it is apt to injure the place by tearing off some of the wood.

Offset is a term sometimes applied to slips from fibrous roots: but more properly so from bulbous roots, which put forth many offsets. These are slipped away at the time they are taken up for removal or replanting, and commonly take two or three years before they bear flowers: dispose of them, therefore, in a nursery, where they may remain undisturbed till they come to a flowering state.

Division of the roots is a way of propagating many sorts of plants. To this end, of course they must be taken up, and then either carefully pulled, or cut asunder with a sharp instrument, as the case may require. It is not safe, however, to divide such roots into very small pieces. The general season for thus splitting fibrous rooted plants is October, but it may be done early in the spring, as February.

Cuttings of a variety of woody plants will grow, and many trees and shrubs are propagated this way; but their sap must be of a watery nature, as those plants that are gummy will not strike (or rarely) though ever so much care is bestowed, or time allowed them. The texture of the wood of cuttings must be somewhat soft, as hard-wooded ones will not grow.

The season for setting slips and cuttings is for some things summer, as wall-flowers and myrtles; and for most from October to March; but, in general, the sooner the better. It has however been said that spring is the best time for all, and that the sap should be in motion first.

Cuttings should be of well-ripened wood, and have the earth pressed to them the whole length they are in the ground; *i. e.* from four to six inches. Cut them with a sharp knife slopewise, and plant in a good soil, and in a situation where they have only the morning sun; and keep them cool (not wet) by occasional watering in dry weather.

Laying of branches is a mode of propagation that may be adopted for almost all forest-trees, and several sorts of fruit-trees and shrubs; *i. e.* all that will grow from cuttings, and many that will not. Layers are made of the lower branches of the plant, and must be young and pliable, to bend down without breaking to the depth of four, five, or six inches in the ground, as the soil is light or heavy, at which they must be held securely by good pegs.

Let the ground about layers be kept cool by occasional waterings, and laying some moss, turf, litter, or rather small pebbles about them, which will not harbour insects. The part out of ground may be supported erectly by a tie to a stick. It is a good way to slit with a sharp knife, the part at the peg, as in carnation layers, a little more than an inch; and some prick a few holes about the part, at a joint, with a blunt awl, to help the layer to strike root. Generally, layers should be shortened to six or eight inches above the ground; or do it to two eyes, be it more or less above ground.

Where there are no branches low enough to be brought into the ground, and it is not thought good to head down for the production of low shoots or suckers, plants may be layered by fixing a broken pot, or a box, with a slit in the side, to the height necessary to lay in a branch. A branch also, if long enough, may be thrust through the hole of a garden-pot upwards, then filled with earth, and supported by some con-

oil with which the cistern is filled to the height of the dotted line, the dipping of the pipe forms a lock by which the return of the gas is prevented. The cistern is formed either of cast iron or lead. F F F F, are the refrigeratory pipes, all connected with the condensing cistern, and connected two and two together at the top by a square box Z, by which the communication between each pair of pipes is formed. Between the first and second, and the third and fourth pipes, are divisions *g g*, crossing the whole width of the cistern, and dipping two or three inches into the oil, forming distinct compartments, by means of which the connection between the first and second pipe is broken off at the bottom, while it is maintained at the top by the square box Z; and the space between the second and third pipe is thus open at bottom, and again between the third and fourth at the top. Hence it is obvious that the gas will travel in the direction of the arrows, and escape from the condenser by the small bent pipe H H H, into the gasometer K K. These pipes may be made of cast iron, lead, or even of strong sheet iron, provided the joints are well made. The gasometer, as represented in the figure, is made of sheet iron, the plates being well rivetted together, and the joinings rendered air-tight by cement. It is suspended by a strong iron chain which works over the pullies, *p p*, and dips into a large tank or reservoir of water W W, and being nicely balanced by the weights R, it will rise in the water as the gas enters, and sink as it escapes by the pipe Y. From the construction of the gasometer, and the method of its suspension, it will appear on inspection, that any requisite degree of pressure for urging the gas along the pipes to the burners may be afforded, by diminishing the number of the moveable weights at R.

L L is the furnace enclosed in an arch of fire brick, on the top of which the retort is placed in the oven M M, the flames passing in the direction of the arrows through the small flame holes, and there, on account of its width, the flames travelling slowly, the whole of the arch, together with the retort, soon become of a red heat, and may be kept at any temperature required by means of a damper placed in the flue N, which leads to the common chimney. O represents the ash-pit of the furnace. Fig. 2. is a transverse section of the apparatus, and requires no description, the letters answering to the description already given.

It may be proper here just to notice the portable gas lamp of Mr. Gordon, which seems now rising into general notice in London, a company having been recently established for the purpose of supplying private families, public offices, ball rooms, theatres, &c. with compressed oil gas in lamps of various sizes, to suit the convenience of the consumer.

A representation of the general form of the portable gas lamp is given in fig. 8. Plate XVII.

The body A is made of strong copper, and may be set in a stand, as seen in the figure, or in any other ornamental support according to the taste of the person who uses it. At B there is a conical valve, similar to that in the reservoir of an air gun; this valve is regulated by means of a screw which presses it inwards, so that the size of the flame may be varied at pleasure; and the whole is surrounded by a moon-glass C, within which is a common glass chimney. Into the reservoir of the lamp any requisite number of atmospheres of gas may be forced by a powerful condensing engine, which, at the company's manufactory, is worked by steam.

To force in the gas into each vessel separately, as the air is forced into the reservoir of an air-gun, would be attended with much inconvenience and expence. To obviate this inconvenience, Mr. Gordon condenses the air in a large vessel of cast iron, from whence it is drawn off into the small reservoir belonging to the individual lamp.

GASTEROSTEUS, the *stickle-back*, in natural history, a genus of fishes of the order Thoracici. There are thirteen species. G. aculeatus, or three spined stickle-back is found in almost all the fresh waters of Europe, and is about three inches long, and in the beginning of the summer displays the most beautiful combination of bright-red, fine olive green, and silvery whiteness. It is extremely active and rapid, and is particularly injurious in fish ponds, as it devours the spawn of the fish. In the fens of Lincolnshire, these fishes appear in immense numbers, and have been frequently sold at the rate of a halfpenny per bushel. They have been often most successfully applied as manure for land.

GASTRIC *juice*, a fluid of the utmost importance in the process of digestion. It does not act indiscriminately on all substances, nor is it the same in all animals, nor does it continue always of the same nature even in the same animal, it changes according to circumstances. It acts with a chemical energy in dissolving food: it attacks the surface of bodies, unites to the particles of them, which it carries off, and cannot be separated from them by filtration. It operates with more energy and rapidity the more the food is divided, and its action is increased by a warm temperature. The food is not merely reduced to very minute parts; its taste and smell are quite changed; its sensible properties are destroyed, and it acquires new and very different ones. This fluid does not act as a ferment, it is a powerful antiseptic, and even restores flesh already putrified.

GASTROBRANCHUS, in natural history, a genus of fishes, of the order Cartilaginei. Generic character; mouth beneath, furnished with pectinal teeth, in a double row on each side: body eel-shaped, carinate beneath by a soft fin, two ventral spiracles. G. cœcus or the hag-fish, is about five inches in length, in the European seas, but, in those of India attains the length of a common eel. It is characterized by the circumstance of exhibiting no traces of the existence of such an organ as the eye. It will often enter the mouths of fishes fixed on the hook of the angler, and gnaw a passage through their bodies, devouring all but the bones and skin. Its substance is so highly glutinous, that a large vessel of sea water will, in a short time after the living cœcus is placed in it, become of the consistence of jelly.

GATE, in architecture, a large door, leading, or giving entrance into a city, town, castle, palace, or other considerable building: or a

place giving passage to persons, horses, coaches, or waggons, &c.

GAVELKIND, a tenure of custom belonging to lands in the county of Kent, by which the lands of the father are at his death, equally divided among all his sons; or the land of a deceased brother, in case he leaves no issue, among all the brethren. This is by some called ancient soccage-tenure: the custom came from our Saxon ancestors, among whom the inheritance of lands did not descend to the eldest, but to all the sons alike; and the reason why it was retained in Kent is, because the Kentish men were not conquered by the Normans. The customs attending this tenure are, that the heir, at the age of fifteen, may give or sell his lands in gavelkind; and though the father is attainted of treason, and suffers death, the son inherits. A wife shall be endowed of a moiety of the gavelkind lands, of which her husband died seised, during her widowhood. Likewise a husband may be tenant by courtesy of half his wife's lands, without having any issue by her; but if he marries again, not having issue, he forfeits his tenancy.

GAUGE-*point*, of a solid measure, the diameter of a circle, the area of which is equal to the solid content of the same measure. Thus the solidity of a wine-gallon being 231 cubic inches, if you conceive a circle to contain so many inches, the diameter of it will be 17.15; and that will be the gauge-point of wine-measure. And if an ale-gallon, containing 282 cubic inches, by the same rule, the gauge-point for ale-measure will be found to be 19.15. After the same manner, may the gauge-point of any foreign measure be obtained; and hence may be drawn this consequence, that when the diameter of a cylinder, in inches, is equal to the gauge-point of any measure, given likewise in inches, every inch in length thereof will contain an integer of the same measure, *e. gr.* in a cylinder whose diameter is 17.15 inches, every inch in height contains one entire gallon in wine-measure; and in another, whose diameter is 18.95 inches, every inch in length contains one ale-gallon.

GAUGING, the art or act of measuring the capacities or contents of all kinds of vessels, and determining the quantities of fluids or other matters contained therein.

As the practice of gauging depends entirely on the art of mensuration, the reader is referred to that article.

GAURA, a genus of the class and order octandria monogynia. There is one species, a biennial plant of North America.

GAURS, for some account of this ancient sect. See Gabres.

GAUZE, in commerce, a thin transparent stuff, sometimes woven with silk, and sometimes only of thread. Gauzes are either plain or figured; the latter are worked with flowers of silver or gold, on a silk ground; and are chiefly imported from China. Gauzes of excellent quality, are now manufactured at Paisley.

GAZELLA. See Antelope.

GAZETTE, a newspaper, or printed account of the transactions of all the countries in the known world, in a loose sheet, or half sheet. This name is with us confined to that paper of news published by authority.

The first gazette in England was published at Oxford, the court being there, Nov. 7, 1665. On the removal of the court to London, the gazette was published there. In this work are recorded all commissions and promotions in the army; all state appointments of consequence, with a variety of matters interesting to men of business and others.

GAZONS, in fortification, pieces of fresh earth, covered with grass, and cut in form of a wedge, about a foot long, and half a foot thick, to line the outsides of works made of earth, as ramparts, parapets, &c.

GELATIN, Gelly, or *jelly*, an animal substance, soluble in water, capable of assuming a well-known elastic or tremulous consistence, by cooling, when the water is not too abundant, and liquefiable again by increasing its temperature. This last property distinguishes it from albumen, which becomes consistent by heat. It is precipitated in an insoluble form by tannin; and it is this action of tannin on gelatin that is the foundation of the art of tanning leather. See Glue.

According to the analysis of MM. Gay Lussac and Thenard, gelatin is composed of

Carbon -	47.881
Oxygen -	27.207
Hydrogen	7.914
Azote	16.998
	100.000

GEMS. This word is used to denote such stones as are considered by mankind as precious. These are, the diamond, the ruby, the sapphire, the topaz, the chrysolite, the beryl, the emerald, the hyacinth, the amethyst, the garnet, the tourmalin, the opal; and to these may be added, rock crystal, the finer flints of pebbles, the cat's eye, the oculus mundi, or hydrophanes, the chalcedony, the moon-stone, the onyx, the cornelian, the sardonyx, agates, and the Labrador-stone.

Gems, *imitation of antique*. There has been at different times a method practised by particular persons, of taking the impressions and figures of antique gems, with their engravings, in glass of the colour of the original gem. This has always been esteemed a very valuable method, and preferable to the more ordinary ones of doing it on sealing-wax or brimstone; but, this art, being a secret only in the hands of some particular persons, it died with them, and every new artist was obliged to re-invent the method; till at length Mr. Homberg, having found it in great perfection, gave the whole process to the world to be no more forgotten or lost; and since that time it has been very commonly practised in France, and other places.

Mr. Homberg was favoured in his attempts with all the engraved gems of the king's cabinet, and took such elegant impressions, and made such exact resemblances of the originals, that the nicest judges were deceived in them, and often mistook them for the true antique stones.

The great care in the operation is, to take the impression of the gem in a very fine earth, and to press down upon this a piece of proper glass, softened or half melted, so that the figures of the impression made in the earth may be nicely and perfectly expressed upon the glass. Of all the species of earth which

Mr. Homberg examined on this occasion. none proved so much divested of salts, or so fit for the purpose, as the common tripoli, used to polish glass and stones.

When the tripoli has been properly prepared it is mixed with water to the consistence of paste; it is then put into a crucible of a flat form, and of about half an inch in depth, and pressed lightly down, after which the surface must be strewed with some dry tripoli of the yellow kind, and the gem of which the impression is to be taken is then to be pressed evenly down into the paste with a finger and thumb, and then carefully removed. When the crucible and paste are dry, a piece of glass must be chosen of a proper colour, and cut to a size proper for the figure; this must be laid over the mould, but in such a manner that it shall not touch the figures, otherwise it would spoil them. The crucible is then to be brought near the furnace by degrees, and gradually heated; then it is to be placed in the furnace under a muffle surrounded with charcoal. Several of these small crucibles may be placed under one muffle; and when they are properly disposed, the aperture of the muffle should have a large piece of burning charcoal put to it, and then the operator must watch the process, and see when the glass begins to look bright; this is the signal of its being fit to receive the impression. The crucible is then to be taken out of the fire, and the hot glass must be pressed down upon the mould with an iron instrument, to make it receive the regular impression; as soon as this is done, the crucible is to be set by the side of the furnace out of the way of the wind, that it may cool gradually without breaking. When it is cold, the glass is to be taken out, and its edges should be grated round with pincers, in order to prevent its flying afterwards, which is an accident that sometimes happens when this caution has been omitted, especially when the glass is naturally tender. This process however is tedious and precarious, and a much simpler method is now made use of, viz. substituting plaster of Paris moulds in place of the tripoli; the other parts of the process being nearly the same as already described.

Of all the artists and ingenious men who have taken impressions of engraved gems in sulphur and in paste, no one seems to have carried that art to such perfection as Mr. James Tassie, a native of Glasgow, and whose method is still practised by his successor Mr. William Tassie of Liecester Square, London.

Mr. Tassie, profiting by the former publications of this sort, and by expence, industry, and access to many cabinets in England and other kingdoms to which former artists had not obtained admission, greatly increased his collection of impressions of ancient and modern gems. It is the greatest collection of this kind that ever existed, and serves for all the purposes of artists, antiquaries, scholars, men of taste, and philosophers. The great demand for his pastes was perhaps owing in the beginning to the London jewellers, who introduced them into fashion by setting them in rings, seals, bracelets, necklaces, and other trinkets.

The reputation of this collection having reached the empress of Russia, she was pleased to order a complete set; which, being accordingly executed in the best and most durable manner, were arranged in elegant cabinets, and are now placed in the noble apartments of her imperial majesty's superb palace at Czarsko Zelo.

Mr. Tassie, in executing this commission, availed himself of all the advantages which the improved state of chemistry, the various ornamental arts, and the knowledge of the age, seemed to afford. The impressions were taken in a beautiful white enamel composition, which is not subject to shrink or form air-bladders, which emits fire when struck with steel, and takes a fine polish, and which shows every stroke and touch of the artist in higher perfection than any other substance. When the colours, mixed colours, and nature of the respective originals, could be ascertained, they were imitated as completely as art can imitate them; insomuch that many of the paste intaglios and cameoes in this collection are such faithful imitations, that artists themselves have owned they could hardly be distinguished from the originals.

Mr. Tassie's collection now amounts to upwards of 20,000 articles.

GENDARMES, or *Gens d'armes*, in the French armies, a denomination given to a select body of horse, on account of their succeeding the ancient gendarmes, who were thus called from their being completely clothed in armour.

GENDER, among grammarians, a division of nouns, or names, to distinguish the two sexes.

GENEALOGICA *arbor*, or tree of consanguinity, signifies a genealogy or lineage drawn out under the figure of a tree, with its root, stock, branches, &c. The genealogical degrees are usually represented in circles, ranged over, under, and aside each other.

GENEALOGY, an enumeration of a series of ancestors: or a summary account of the relations and alliances of a person or family, both in the direct and collateral line.

GENERAL, in a military sense, is an officer in chief, to whom the prince or senate of a country have judged proper to intrust the command of their troops. He holds this important trust under various titles: as captain-general, in England and Spain; feldt mareschal in Germany, or mareschal in France.

In the British service the king is constitutionally, and in his own proper right, captain-general. He has ten aid-de-camps: every one of whom enjoys the brevet rank of full colonel in the army. Next to his majesty is the commander-in-chief, whom he sometimes honours with the title of captain-general.

GENERALISSIMO, a supreme and absolute commander in the field. This word is generally used in most foreign languages. It was first invented by the absolute authority of cardinal Richelieu, when he went to command the French army in Italy.

GENERAL *issue*, in law, is that plea which traverses and denies at once, the whole declaration or indictment, without offering any special matter, whereby to evade it: and it is called the general issue, because, by importing an absolute and general denial of what is alleged in the declaration, it amounts at once to an issue; that is, a fact affirmed on one side, and denied on the other. This is the ordinary

plea upon which most causes are tried, and is now almost invariably used in all criminal cases. It puts every thing in issue, that is, denies every thing, and requires the party to prove all that he has stated.

GENERATING *line*, or *figure*, in geometry, is that by which its motion produces any other plane or solid figure. Thus a right line moved any way parallel to itself, generates a parallelogram; round a point in the same plane, with one end fastened in that point, it generates a circle. One entire revolution of a circle, in the same plane, generates the cycloid; and the revolution of a semi-circle round its diameter, generates a sphere, &c.

GENERATION. See PHYSIOLOGY.

GENERICAL *name*, in natural history, the word used to signify all species of natural bodies, which agree in certain essential and peculiar characters, and therefore all of the same family or kind; so that the word used as the generical name, equally expresses every one of them, and some other words expressive of the peculiar qualities of figures of each are added, in order to denote them singly, and make up what is called the specific name. Thus the word rosa, or rose, is the generical name of the whole series of flowers of that kind, which are distinguished by the specific names of the red-rose, the white-rose, the apple-rose, &c.

GENEVA, *gin*, a hot fiery spirit, too much used by the lower classes of people in this country, as a dram, and is unquestionably most injurious to their constitution and morals. A liquid of this kind was formerly sold in apothecaries' shops, drawn from the juniper-berry, but distillers now have completely supplanted the trade of the apothecary, who sell it under the name of geneva, or gin, in which juniper-berries make no part of the composition. It is composed of oil of turpentine, and malt spirits. The Hollands geneva is manufactured chiefly at a village near Rotterdam, from wheat and juniper-berries.

GENIOSTOMA, a genus of the monogynia order, in the pentandria class of plants. There is one species, a native of the South Seas.

GENISTA, BROOM, or DYER'S WEED, a genus of the decandria order, in the diadelphia class of plants, and in the natural method ranking under the 32d order papilionaceæ. There are 17 species, of which the most remarkable are the cytiso-genista, or common broom, and the tinctoria, or dyer's-weed.

GENIUS, in matters of literature, &c. a natural talent or disposition to do one thing more than another; or the aptitude a man has received from nature to perform well and easily that which others can do but indifferently, and with a great deal of pains.

GENTIANA, *gentian*, a genus of the digynia order, in the pentandria class of plants, and in the natural method ranking under the 20th order, rotaceæ. There are 53 species. The most remarkable are the following:

1. The *lutea*, or common gentian of the shops. This is a native of the mountainous parts of Germany, whence the roots, the only part used in medicine, are brought to this country. They have a yellowish-brown colour, and a very bitter taste.

2. The *centaureum*, or lesser centaury of the shops, is a native of many parts of Britain. It grows on dry pastures, and its height is commonly proportioned to the goodness of the soil. It is an annual plant, with upright branching stalks, and small leaves, placed by pairs.

3. The *acaulis*, a beautiful little plant for the flower garden, conspicuous for its fine changeable azure blue flowers. It is a native of the Alps

GENUS, among metaphysicians and logicians, denotes a number of beings, which agree in certain general properties, common to them all.

GENUS, in natural history, a subdivision of any class or order of natural beings, whether of the animal, vegetable, or mineral kingdoms, all agreeing in certain common characters.

GEOCENTRIC, in astronomy, is applied to a planet or its orbit to denote it concentric with the earth.

GEOCENTRIC *latitude of a planet*, is its distance from the ecliptic, as it is seen from the earth.

GEOCENTRIC *place of a planet*, the place in which it appears to us from the earth, supposing the eye there fixed: or it is a point in the ecliptic in which a planet seen from the earth is referred.

GEOGRAPHY, is a term derived from two Greek words γη or γεα *the earth*, and γραφω *I write*, and properly signifies *a description of the earth*.

What is called general geography embraces a wide view of the subject; regarding the earth astronomically as a planet, the grand divisions of land and water, the winds, tides, meteorology, and may extend to what is called mechanical geography, including directions for the construction of globes, maps, and charts. The study of geography being of so much practical importance in life, must have commenced in the early ages of the world. It was regarded as a science by the Babylonians and Egyptians, from whom it passed to the Greeks, and from these to the Romans, the Arabians, and the western nations of Europe. Thales of Miletus, in the 6th century before Christ, first made observations on the apparent progress of the sun from tropic to tropic; and is said to have written two treatises, the one on the tropic, and the other on the equinox, whence he was led to the discovery of the four seasons, which are determined by the equinoxes and solstices. We are assured this knowledge was obtained by means of the gnomon. Thales, it is also said, constructed a globe, and represented the land and sea upon a table of brass.

Maps at first were little more than rude outlines, and topographical sketches of different countries. The earliest on record were those of Sesostris, mentioned by Eustathius, who says that "this Egyptian king, having traversed great part of the earth, recorded his march in maps, and gave copies of them not only to the Egyptians, but to the Scythians, to their great astonishment." Some have imagined, with much probability, that the Jews made a map of the Holy Land, when they gave the different portions to the nine tribes at Shiloh; for Joshua tells us that they were sent

to walk through the land, and that they described it in seven parts of a book; and Josephus relates that when Joshua sent out people from the different tribes to measure the land, he gave them as companions persons well skilled in geometry, who could not be mistaken in the truth.

The first Grecian map on record was that of Anaximander, mentioned by Strabo, supposed to be that referred to by Hipparchus under the designation of the ancient map.

Eratosthenes first attempted to reduce geography to a regular system, and introduced a regular parallel of latitude, which began at the straits of Gibraltar, passed eastward through the isle of Rhodes, and so on to the mountains of India, noting all the intermediate places through which it passed. In drawing this line, he was not regulated by the same latitude, but by observing where the longest day was 14 hours and a half, which Hipparchus afterwards determined was the latitude of 36 degrees.

This first parallel through Rhodes was ever after considered with a degree of preference, in constructing all the ancient maps; and the longitude of the then known world was often attempted to be measured in stadia and miles, according to the extent of that line, by many succeeding geographers.

Though the maps of Eratosthenes were the best of his time, they were yet very imperfect and inaccurate. They contained little more than the states of Greece, and the dominions of the successors of Alexander, digested according to the surveys above-mentioned. He had indeed seen, and has quoted, the voyages of Pythias into the great Atlantic ocean, which gave him some faint ideas of the western parts of Europe; but so imperfect, that they could not be realized into the outlines of a chart Strabo says he was very ignorant of Gaul, Spain, Germany, and Britain; and he was equally ignorant of Italy, the coast of the Adriatic, Pontus, and all the countries towards the north.

Such was the state of geography, and the nature of the maps, before the time of Hipparchus. He made a closer connection between geography and astronomy, by determining the latitudes and longitudes from celestial observations.

The Roman empire had been enlarged to its greatest extent, and all its provinces well known and surveyed, when Ptolemy, about 150 years after Christ, composed his system of geography. The chief materials he employed in composing this work, were the proportions of the gnomon to its shadow, taken by different astronomers at the times of the equinoxes and solstices; calculations founded on the length of the longest days; the measured or computed distances of the principal roads contained in their surveys and itineraries; and the various reports of travellers and navigators. All these were compared together, and digested into one uniform body or system; and afterwards were translated by him into a new mathematical language, expressing the different degrees of latitude and longitude, after the invention of Hipparchus, which had been neglected for 250 years.

Ptolemy's system of geography, notwithstanding it was still very imperfect, continued in vogue till the last three or four centuries, within which time the great improvements in astronomy, the many discoveries of new countries by voyagers, and the progress of war and arms, have contributed to bring it to a very considerable degree of perfection.

General Principles of Geography.

The general principles of geography are, the spherical figure of the earth, its rotation on its axis, its revolution round the sun, and the position of the axis or line round which it revolves with regard to the celestial luminaries. That the earth and sea taken together constitute one vast sphere is demonstrable by the following arguments: 1. To people at sea the land disappears, though near enough to be visible, was it not for the intervening convexity of the water. 2. The higher the eye is, the more extensive is the prospect; whence it is common for sailors to climb up to the tops of the masts to discover land or ships at a distance. 3. To people on shore, the mast of a ship at sea appears before the hull; but were the earth an even plane, not the highest objects, but the largest, would be longest visible. 4. The convexity of any piece of still water of a mile or two in extent may be perceived by the eye A little boat, for instance, may be perceived by a man who is any height above the water; but if he stoops down or lays his eye near the surface, he will find that the fluid appears to rise and intercept the view of the boat entirely. 5. The earth has been often sailed round, as by Magellan, Drake, Dampier, Anson, Cook, and many other navigators, which demonstrates that the surface of the ocean is spherical.

A great many of the terrestrial phenomena depend upon the globular figure of the earth, and the position of its axis with regard to the sun, particularly the rising and setting of the celestial luminaries, the length of the days and nights, &c.

Though the sun rises and sets all over the world, the circumstances of his doing so are very different in different countries. The most remarkable of these circumstances is the duration of the light, not only of the sun himself, but of the twilight before he rises and after he sets. In the equatorial regions, darkness comes on very soon after sunset. In our climate the twilight always continues about two hours, and during the summer season it continues in a considerable degree during the whole night. In countries farther to the northward or southward, the twilight becomes brighter and brighter as we approach the poles, until at last the sun does not appear to touch the horizon, but goes in a circle at some distance above it for many days successively. In like manner, during the winter, the same luminary sinks lower and lower, until at last he does not appear at all; and there is only a dim twinkling of twilight for an hour or two in the middle of the day. By reason of the refraction of the atmosphere, however, the time of darkness, even in the most inhospitable climates, is always less than that of light. In the warmer climates the sun has often a beautiful appearance at rising and setting, from the refraction of his light through the vapours which are copiously raised in those parts. In the colder regions, halos, parhelia, aurora

borealis, and other meteors, are frequent; the two former owing to the great quantity of vapour continually flying from the warm regions of the equator to the colder ones of the poles. In the high northern latitudes, thunder and lightning are unknown, or but seldom heard of; but the more terrible phenomena of earthquakes, volcanoes, &c. are by no means unfrequent. These, however, seem only to affect islands and the maritime parts of the continent.

Were the earth a perfect plane, the sun would appear to be vertical in every part of it; for, in comparison with the immense magnitude of that luminary, the diameter of this globe itself is but very small; and as the sun, were he near to us, would do much more than cover the whole earth, so, though he were removed to any distance, the whole diameter of the latter would make no difference in the apparent angle of altitude. By means of the globular figure of the earth also, along with the great disparity between the diameters of the two bodies, some advantage is given to the day over the night; for thus the sun, being immensely the larger of the two, shines upon more than one half of the earth; whence the unenlightened part has a shorter way to go before it again receives the benefit of his rays. This difference is greater in the inferior planets Venus and Mercury than in the earth.

To the globular figure of the earth likewise is owing the long moonlight which the inhabitants of the polar regions enjoy. The same thing likewise occasions the appearance and disappearance of certain stars at some seasons of the year in some countries; for, were the earth flat, they would all be visible in every part of the world at the same time.

In geography the circles which the sun apparently describes in the heavens are supposed to be extended as far as the earth, and marked on its surface; and in like manner we may imagine as many circles as we please to be described on the earth, and their planes to be extended to the celestial sphere, till they mark concentric ones on the heavens. The most remarkable of those supposed by geographers to be described in this manner are the following:

1. The horizon. This is probably a double circle, one of the horizons being called the sensible, and the other the rational. The former comprehends only that space which we can see around us upon any part of the earth, and which is very different according to the difference of our situation. The other, called the rational, is a circle parallel to the former, and passing through the centre of the earth, supposed to be continued as far as the celestial sphere itself. To the eyes of the spectators there is always a vast difference between the sensible and rational horizons; but from the immense disparity betwixt the size of the earth and celestial sphere, planes of both circles may be considered as coincident. Hence in geography, when the horizon, or plane of the horizon, is spoken of, the rational is always understood when nothing is said to the contrary. In consequence of the round figure of the earth, every part has a different horizon. The poles of the horizon, that is, the points directly above the head, and opposite to the feet of the observer, are called the zenith and nadir.

2. A great circle described upon the sphere of the heaven, and passing through the two vertical points, is called a vertical circle, or an azimuth; and of these we may suppose as many as we please all round the horizon. In geography every circle obtains the epithet of great, whose plane passes through the centre of the earth; in other cases they are called lesser circles.

3. Almucantars are circles supposed to be drawn upon the sphere parallel to the horizon, and grow less and less as they approach the vertical points, where they entirely vanish.

The apparent distances between any two celestial bodies are measured by supposing arches of great circles drawn through them, and then finding how many degrees, minutes, &c. of these circles are intercepted between them.

4. Sometimes the visible horizon is considered only with regard to the objects which are upon the earth itself, in which case we may define it to be a lesser circle on the surface of the earth, comprehending all such objects as are at once visible to us; and the higher the eye, the more is the visible horizon extended. It is most accurately observed, however, on the sea, on account of the absence of those inequalities which at land render the circle irregular.

5. The equator is a great circle upon the earth, every part of which is equally distant from the poles or extremities of the imaginary line on which the earth revolves. In sea-language, it is usually called the line.

6. The meridian of any place is a great circle on the earth drawn through that place and both poles of the earth. It cuts the horizon at right angles, marking upon it the true north and south points; dividing also the globe into two hemispheres, called the eastern and western, from their relative situation to that place and to one another. The poles divide the meridians into two semicircles, one of which is drawn through the place to which the meridian belongs, the other through that point of the earth which is opposite to the place. By the meridian of a place, geographers and astronomers often mean that semicircle which passes through the place, and which may therefore be called the geographical meridian. All places lying under this semicircle are said to have the same meridian; the semicircle opposite to this is called the opposite meridian. The meridians are thus immoveably fixed to the earth as much as the places themselves on its surface, and are carried along with it in its diurnal rotation. When the geographical meridian of any place is, by the rotation of the earth, brought to point at the sun, it is noon or mid-day at that place. The rotation of the earth is from west to east; whence the celestial bodies appear to move the contrary way. East and west, however, are terms merely relative, since a place may be west from one part of the earth, and east from another; but the true east and west points from any place are those where its horizon cuts the equator.

7. All places lying under the same meridian are said to have the same longitude, and those which lie under different meridians to have different longitudes; the difference of longitude being reckoned eastward or westward on the equator. Thus, if the meridian of any place cuts the equator in a point 15 degrees dis

tant from one another, we say there is a difference of 15° longitude betwixt these two places. Geographers usually fix upon the meridian of some remarkable place for the first meridian, and reckon the longitude of all others by the distance of their meridians from that which they have determined upon as the first; measuring sometimes eastward on the equator all around the globe, or sometimes only one half east and the other west; according to which last measurement no place can have more than 180° longitude either east or west. By the British geographers the royal observatory at Greenwich is accounted the place of the first meridian.

8. If we suppose 12 great circles, one of which is the meridian to a given place, to intersect each other at the poles of the earth, and divide the equator into 24 equal parts, these are the hour-circles of that place. These are by the poles divided into 24 semicircles, corresponding to the 24 hours of the day and night. The distance betwixt each two of these semicircles is 15°, being the 24th part of 360; and by the rotation of the earth each succeeding semicircle points at the sun one hour after the preceding: so that in 24 hours all the semicircles point successively at the sun. Hence it appears, that such as have their meridian 15° east from any other have likewise noon one hour sooner, and the contrary; and in like manner every other hour of the natural day is an hour sooner at the one place than at the other. Hence, from any instantaneous appearance in the heavens observed at two distant places, the difference of longitude may be found, if the hour of the day is known at each place. Hence also, were a man to travel or sail round the earth from west to east, he would reckon one day more to have passed than they do who stay at the place whence he set out; so that their Monday would be his Tuesday, &c.

9. The equator divides the earth into two hemispheres, called the northern and southern; all places lying under the equator are said to have no latitude; and all others to have north or south latitude according to their situation with respect to the equator. The latitude itself is the distance from the equator measured upon the meridian, in degrees, minutes, and seconds. The complement of latitude is the difference between the latitude itself and 90°, or as much as the place itself is distant from the pole; and this complement is always equal to the elevation of the equator above the horizon of the place. An inhabitant of the earth at either of the poles would have always one of the celestial poles in his zenith, and the other in his nadir, the equator coinciding with the horizon.

Those who live under the equator have both poles in the horizon, all the celestial parallels cutting the horizon, at right angles. Lastly, those who live between either of the poles and the equator, are said to live in an oblique sphere, or to have an oblique horizon, because the celestial equator cuts their horizon obliquely, and all the parallels in the celestial sphere have their planes oblique to that of the horizon.

By the arctic and antarctic circles, however, modern geographers understand two fixed circles at the distance of 23½ degrees from the pole. These are supposed to be described by the poles of the ecliptic, and mark out the space all around the globe where the sun appears to touch the horizon at midnight in the summer time, and to be entirely sunk below it in the winter. These are also called the polar circles.

According to the different positions of the globe with regard to the sun, the celestial bodies will exhibit different phenomena to the inhabitants. Thus, in a parallel sphere, they will appear to move in circles round the horizon; in a right sphere they would appear to rise and set as at present, but always in circles, cutting the horizon at right angles; but in an oblique sphere the angle varies according to the degree of obliquity, and the position of the axis of the sphere with regard to the sun. Hence we easily perceive the reason of the sun's continual change of place in the heavens; but though it is certain that this change takes place every moment, the vast distance of the luminary renders it imperceptible for some time, unless to very nice astronomical observers. Twice a-year he is in the equator, and then the days and nights are nearly equal all over the earth. This happens in the months of March and September; after which the sun proceeding either northward or south, according to the season of the year and the position of the observer, the days become longer or shorter than the nights, and summer or winter comes on. The secession of the sun from the equator either northward or southward is called his declination, and is either north or south according to the season of the year; and when this declination is at its greatest height, he is then said to be in the tropic, because he begins to turn back (the word tropic being derived from the Greek *τρεπω, verto*). The space between the two tropics, called the torrid zone, extends 47 degrees of latitude all round the globe; and throughout the whole of that space the sun is vertical to some of the inhabitants twice a year, but to those who live directly under the tropics only once. Throughout the whole torrid zone also there is little difference between the length of the days and nights.

From an observation of the diversity in the length of the days and nights, the rising and setting of the sun, with the other phenomena already mentioned, geographers divide the surface of the earth into certain districts, which they call climates. This method of dividing the surface of the earth into climates is not of real practical utility, since it does not furnish any certain criterion for judging of the climate in a meteorological point of view.

From the various appearances of the sun, and the effects of his light and heat upon different parts of the earth, the division of it into zones has arisen. These are five in number. 1. The torrid zone, lying between the two tropics for the space of 47° of latitude. This is divided into two equal parts by the equator. 2. The two temperate zones lie between the polar circles and the tropics, containing a space of 43° of latitude. And, 3. The two frigid zones lie between the polar circles and the poles. In these last the longest day is never below 24 hours; in the temperate zones it is never quite so much, and in the torrid zone it is never above 14. The zones are named from the degree of heat they were supposed to be subjected to. The torrid zone was supposed

by the ancients to be uninhabitable, on account of its heat; but this is now found to be a mistake, and many parts of the temperate zones are warmer than the torrid zone itself. Towards the polar circles also these zones are extremely cold during the winter season. Only a small part of the northern frigid zone, and none of the southern, is inhabited. Some geographers reckoned six zones, dividing the torrid zone into two by the equator.

Besides these there are other terms belonging to geography which it is necessary to explain.

A *continent* is a large portion of the earth, which comprehends several countries that are not separated by any sea; such are Europe, Asia, Africa, and America. An *island* is part of the earth entirely surrounded by water; as Great Britain. A *peninsula* is a tract of land almost surrounded with water, and is joined to a continent only by a narrow neck; such is the Morea in Greece. An *isthmus*, or neck of land, is that part by which a peninsula is joined to a continent, or two continents together; as the isthmus of Suez, which joins Africa to Asia. A *promontory*, or cape, is a high part of land which stretches into the sea; thus the Cape of Good Hope is a promontory. An *ocean* is a vast collection of waters surrounding a considerable part of the continent; as the Atlantic. A *sea* is a smaller collection of waters; as the Black Sea. A *gulf* is a part of the sea which is nearly surrounded with land; as the gulf of Venice. A *bay* has a wider entrance than a gulf; as the Bay of Biscay. A *strait* is a narrow passage that joins two seas; as the Strait of Gibraltar, which joins the Mediterranean to the Atlantic. A *lake* is a large collection of water entirely surrounded by land, having no visible communication with the sea; as the Caspian in Asia. A *river* is a stream of water that has its source from a spring, which keeps constantly running till it falls into some other river, or into the sea.

The ancients considered the globe under the three grand divisions of Asia, Europe, and Africa. Modern discoveries have added a fourth division, that of America, which, exceeding even Asia in size, might have been admitted under two grand and distinct denominations, limited by the isthmus of Darien. The vast extent of New Holland which seems too large to be ranked among islands, and too small for a continent, eludes the petty distinctions of man; and geographers hesitate whether to ascribe it to Asia, or to denominate it a fifth specific division of the earth.

Of the grand divisions of the earth, Asia has ever been esteemed the most populous; and is supposed to contain five hundred millions of souls. The population of Africa may be estimated at thirty millions, of America at twenty millions, and two hundred millions may perhaps be assigned to Europe.

The natural division of the surface of the globe is into sea and land; about three-fourths of the whole being occupied by water. The remaining fourth consists of lands, elevated more or less above the level of the sea, interspersed, in some parts, with smaller collections of water, at various heights, and in a few instances, somewhat lower than the general surface of the main ocean. Thus the Caspian Sea is said to be about three hundred feet lower than the ocean.

The great continent, composed of Europe, Asia, and Africa, constitutes about a seventh of the whole surface of the earth; America about a sixteenth; and Australasia, or New South Wales, about a fiftieth; or in hundredth parts of the whole, Europe contains two; Asia, seven; Africa, six; America, six; and Australasia, two; the remaining seventy-seven being sea; although some authors assign seventy-two parts only out of one hundred to the sea, and twenty-eight to the land.

The general inclinations and levels of the continents are discovered by the course of their rivers. Of these the principal are, the river of Amazons, the Senegal, the Nile, the river St. Lawrence, the Hoangho, the river La Plata, the Yenisei, the Mississippi the Volga, the Oby, the Amur, the Oronooko, the Ganges, the Euphrates, the Danube, the Don, the Indus, the Dnieper, and the Dwina; and this is nearly the order of their magnitudes. But if we class them according to the length of country through which they run, the order will, according to Major Rennel's calculation, be somewhat different; taking the length of the Thames for unity, he estimates that of the river of Amazons, at 15¾; the Kian Kew, in China, 15½; the Hoangho, 13½; the Nile, 12½; the Lena, 11½; the Amur, 11; the Oby, 10½; the Yenisei, 10; the Ganges, its companion the Burrampooter, the river of Ava, and the Volga, each 9½; the Euphrates, 8½; the Mississippi, 8; the Danube, 7; the Indus, 5½; and the Rhine, 5¼.

The grandest concavity of this globe is filled by the Pacific Ocean; occupying nearly half its surface from the eastern shores of New Holland, to the western coast of America, and diversified with several groups of islands, which seem in a manner the summits of vast mountains emerging from the waves This ocean receives but few rivers, the chief being the Amur from Tartary, the Hoan Ho and Kian Kew from China, while the principal rivers of America run towards the east.

Next to this in magnitude is the Atlantic, between the Old and New Continents; and the third is the Indian Ocean. The seas between the arctic and antarctic circles and the poles, have been sometimes styled the Arctic and Antarctic Oceans; but the latter is only a continuation of the Pacific, Atlantic, and Indian Oceans; while the Arctic Sea is partly embraced by continents, and receives many important rivers. Besides these, there are other seas more minute, as the Mediterranean, the Baltic, and others still smaller, till we come by due gradation to inland lakes of fresh water.

The courses of rivers are sometimes marked by oblong concavities, which generally at first intersect the highest grounds, till the declivity becomes more gentle on their approach towards their inferior receptacles. But even large rivers are found sometimes to spring from lowland marshes, and wind through vast plains, unaccompanied by any concavity, except that of their immediate course; while on the other hand, extensive vales, and low hollow spaces, frequently occur destitute of any stream. Rivers will also sometimes force a passage where nature has erected mountains and rocks against it, and where the concavity would appear to be

in another direction, which the river might have gained with more ease. In like manner, though the chief mountains of Europe extend in a south-easterly and north-westerly direction, yet there are so many exceptions, and such numerous and important variations in other parts of the globe, as to render any attempt at a general theory vain.

Prom the vast expanse of oceanic waters, arises in the ancient hemisphere, that wide continent, which contains Asia, Europe, and Africa: and in the modern hemisphere the continent of America, which forms a kind of separate island, divided by a strait of the sea from the ancient continent. But the grandest division of the ancient continent is Asia, the parent of nations, and of civilization: on the north-east and south, surrounded by the ocean; but on the west, divided by an ideal line from Africa; and from Europe by boundaries not very strongly impressed by the hand of nature. The Russian and the Turkish empires, extending over large portions of both continents, intimately connect Asia with Europe. But for the sake of clearness and precision, geographers retain the strict division of the ancient continent into three parts, which if not strictly natural, is ethical, as the manners of the Asiatic subjects of Russia, and even of Turkey, differ considerably from those of the European inhabitants of those empires.

A description of the four quarters of the globe, and of the several kingdoms and states into which they are divided, belongs rather to a work devoted exclusively to geography, than to a dictionary of arts and sciences: we shall therefore forbear entering more into detail in this article.

GEOLOGY. The term geology is used to signify a description of the structure of the earth. As a branch of inductive science, geology is of very modern date; for though the attention of men has long been directed to a theory of the earth, the formation of such a theory is incompatible with any but an advanced state of physical knowledge. Few studies, indeed, are attended with greater difficulty; none in which the subject is more complex; appearances so diversified and scattered; and where the causes that have operated are so remote from the sphere of ordinary observation. Works on the subject of geology are multiplying at the present time with unexampled rapidity; to suppose, however, that they are all either interesting or useful would be absurd; and the inquirers on this interesting subject will find the most satisfactory and scientific information from the writings of such men as Greenough, Conybeare, Philiips, Buckland, D' Aubuisson; and the justly celebrated Cuvier.

The following brief sketch of the subject is taken from the excellent view given of this science in a work by Messrs. Conybeare and Phillips, entitled Outlines of the Geology of England and Wales. Some additions by Dr. Ure occasionally occur, and are marked with asterisks. This study may be divided, like most others, into two parts; observation and theory. By the first we learn the relative positions of the great rocks or mineral aggregates that compose the crust of our globe; through the second, we endeavour to penetrate into the causes of these collocations.

WERNER'S *Table of the different Mountain Rocks, from Jameson.*

CLASS I.—*Primitive rocks.*

1. Granite. 2. Gneiss. 3. Mica-slate. 4. Clay-slate. 5. Primitive limestone. 6. Primitive trap. 7. Serpentine. 8. Porphyry. 9 Syenite. 10. Topaz-rock. 11. Quartz-rock. 12. Primitive flinty-slate. 13. Primitive gypsum. * 14. White stone.

CLASS II.—*Transition rocks.*

1. Transition limestone. 2. Transition trap. 3. Greywacke. 4. Transition flinty-slate. 5. Transition gypsum

CLASS III.—*Floetz rocks.*

1. Old red sandstone, or first sandstone formation. 2. First or oldest floetz limestone. 3. First or oldest floetz gypsum. 4. Second or variegated sandstone formation. 5. Second floetz gypsum. 6. Second floetz limestone. 7. Third floetz limestone. 8. Rock salt formation. 9. Chalk formation. 10. Floetz trap formation. 11. Independent coal formation. 12. Newest floetz-trap formation.

CLASS IV.—*Alluvial rocks.*

1. Peat. 2. Sand and gravel. 3. Loam 4. Bog-iron ore. 5. Nagelfluh. 6. Calc-tuff. 7. Calc-sinter.

CLASS V.—*Volcanic rocks.*

* Pseudo-volcanic rocks.

1. Burnt clay. 2. Porcelain jasper. 3. Earth slag. 4. Columnar clay ironstone. 5. Polier, or polishing slate.

** *True volcanic rocks.*

1. Ejected stones and ashes. 2. Different kinds of lava. 3. The matter of muddy eruptions.

The primitive rocks lie undermost, and never contain any traces of organized beings imbedded in them. The transition rocks contain comparatively few organic remains, and approach more nearly to the chemical structure of the primitive, than the mechanical of the secondary rocks. As these transition rocks were taken by Werner from among those which in his general arrangement were called secondary, the formation of that class made it necessary to abandon the latter term. To denote the mineral masses reposing in his transition series, he accordingly employed the term floetz rocks, from the idea that they were generally stratified in planes nearly horizontal, while those of the older strata were inclined to the horizon at considerable angles. But this holds good with regard to the structure of those countries only which are comparatively low in the Jura chain, and on the borders of the Alps and Pyrenees, Werner's floetz formations are highly inclined. Should we therefore persist in the use of this term, says Mr. Conybeare, we must prepare ourselves to speak of vertical beds of floetz, (*i. e.* horizontal,) limestone, &c. As the inquiries of geologists extended the knowledge of the various formations, Werner, or his disciples, found it necessary to subdivide the bulky class of floetz rocks into floetz and newest floetz, thus completing a fourfold enumeration. Some writers have bestowed the term *tertiary* on the newest floetz rocks of Werner. The following synoptical view of geological arrangement is given by the Rev Mr. Conybeare.

CHARACTER.	PROPOSED NAMES.	WERNERIAN NAMES.	OTHER WRITERS.
1. Formations (chiefly of *sand* and *clay*) above the chalk.	*Superior order.*	Newest floetz class.	Tertiary class.
2. Comprising, a. Chalk. b. Sands and clays, *beneath the chalk.* c. Calcareous freestones (*oolites*) and argillaceous beds. d. *New red sandstone, conglomerate, and magnesian limestone.*	*Supermedial order.*	Floetz class.	Secondary class.
3. Carboniferous rocks, comprising, a. *Coal measures.* b. *Carboniferous limestone.* c. *Old red sandstone.*	*Medial order.*	Sometimes referred to the preceding, sometimes to the succeeding class, by writers of these schools; very often the coal measures are referred to the former, the subjacent limestone and sandstone to the latter.	
4. *Roofing slates,* &c. &c.	*Submed. order.*	Transition class.	Intermed. class.
5. *Mica slate, gneiss, granite,* &c.	*Inferior order.*	Primitive class.	Primitive class.

In all these formations, from the lowest to the highest, we find a repetition of rocks and beds of similar chemical composition; i. e. siliceous, argillaceous, and calcareous, but with a considerable difference in texture; those in the lowest formations being compact and often crystalline, while those in the highest and most recent are loose and earthy. These repetitions form what the Wernerians call formation suites. We may mention,

1. The *limestone suite.* This exhibits, in the inferior or primitive order, crystalline marbles; in the two next, or transition and carboniferous orders, compact and subcrystalline limestones (Derbyshire limestone;) in the supermedial or floetz order, less compact limestone (lias,) calcareous freestone (Portland and Bath stone,) and chalk; in the superior or newest floetz order, loose earthy limestones.

2. The *argillaceous suite* presents the following gradations; clay-slate, shale of the coal measures, shale of the lias, clays alternating in the oolite series, and that of the sand beneath the chalk; and, lastly, clays above the chalk.

3. The *siliceous suite* may (since many of the sandstones of which it consists present evident traces of felspar and abundance of mica, as well as grains of quartz, and since mica is more or less present in every bed of sand,) perhaps deserve to have granite placed at its head, as its several members may possibly have been derived from the detritus of that rock: it may be continued thus; quartz rock and transition sandstone, old red sandstone, millstone-grit, and coal-grits, new red sandstone, sand, and sandstone beneath the chalk, and above the chalk. In all these instances a regular diminution in the degree of consolidation may be perceived in ascending the series

We noticed before, that the remains of vegetables and animals are confined to the secondary formations. We have now to add, that they are not irregularly dispersed throughout the whole series of these formations, but disposed as it were in families, each formation containing an association of species peculiar in many instances to itself, widely differing from those of other formations, and accompanying it throughout its whole course; so that at two distinct points on the line of the same formation, we are sure of meeting the same general assemblage of fossil remains. It will serve to exemplify the laws which have been stated, if the observer's attention is directed to two of the most prominent formations of this island; namely, the chalk and the limestone which underlie the coal in Northumberland, Derbyshire, South Wales, and Somerset. Now if he examines a collection of fossils from the chalk of Flamborough-Head, or from that of Dover-Cliffs, or, it may be added, from Poland or Paris, he will find eight or nine species out of ten the same; he will observe the same echinites associated with the same shells; nearly one-half of these echinites he will perceive to belong to divisions of that family unknown in a recent state, and indeed in any other fossil bed except the chalk. If he next proceeds to inspect parcels of fossils from the carboniferous limestone, he will in the same manner find them to agree with each other, from whichever of the above localities they may have been brought; that is, he will find the same corals, the same ehcinites, the same productæ, terebratulæ, spiriferæ, &c. But, lastly, if he compares the collection from the chalk with that from the mountain lime, he will not find one single instance of specific agreement, and in very few instances any thing that would deceive even an

unpractised eye, by the superficial resemblance of such an agreement.

If we cast a rapid view over the phenomena of this distribution, the subject must appear to present some of the most singular problems which can engage the attention of the inquirer into nature. First, We have a foundation of primitive rocks destitute of these organic remains; in the next succeeding series (that of transition,) corals, encrinites, and testacea, different however from those now known, appear at first sparingly. The fossil remains of the carboniferous limestone are nearly of the same nature with those in the transition rocks, but more abundant; the coal-measures (coal strata,) however, themselves, which repose on this limestone, present scarcely a single shell or coral; but, on the contrary, abound with vegetable remains, ferns, flags, reeds of unknown species, and large trunks of succulent plants, *strangers to the present globe.* Upon the coal rest beds again containing marine remains (the magnesian limestone), then a long interval (of new red sandstone) intervenes, destitute almost, if not entirely, of organic remains, preparing the way, as it were, for a new order of things. This order commences in the lias, and is continued in the oolites, green and iron sands, and chalk. All these beds contain corals, encrinites, echinites, testacea, crustacea, vertebral fishes, and marine oviparous quadrupeds, yet widely distinguished from the families contained in the lower beds of the transition and carboniferous class, and particularly distinguished among themselves, according to the bed which they occupy. Hitherto the remains are always petrified, i. e. impregnated in the mineral substance in which they are imbedded. But, lastly, in the strata which cover the chalk, we find the shells merely preserved, and in such a state that when the clay or sand in which they lie is washed off, they might appear to be recent, had they not lost their colour, and become more brittle. Here we find beds of marine shells alternating with others peculiar to fresh water, so that they seem to have been deposited by *reciprocating inundations of fresh and salt water.* In the highest of the regular strata, the crag, we at length can find an identity with the shells at present existing on the same coast; and, lastly, over all these strata indiscriminately there is spread a covering of gravel (seemingly formed by the action of a deluge, which has detached and rounded by attrition fragments of the rocks over which it swept,) containing the remains of numerous land quadrupeds, many of them of unknown genera or species (the mastodon, and the fossil species of elephant, or mammoth, bear, rhinoceros, and elk,) mingled with others (hyænas, &c.) equally strangers to the climates where they are now found, yet associated with many at present occupying the same countries.

Another class of substances imbedded in the secondary strata, and throwing light on the convulsions amidst which they have been formed, are the pebbles, or rolled fragments of rocks, older than themselves, which they are often found to contain.

The necessary inferences from this fact are, first, The rock whence the fragments were derived must have been consolidated, and, subsequently to that consolidation, have been exposed to the mechanical violence (probably the action of agitated waters) which tore from it these masses, and rounded them by attrition, before the rock in which these fragments are now imbedded was formed: and, secondly, Since loose gravel beds (and such must have been the original form of these, though now consolidated into conglomerate rocks) cannot be accumulated to any extent from the action of gravity on a highly inclined plane, we are sure, when we find such beds, as we often do in nearly vertical strata, that this cannot have been their original position, but is one into which they have been forced by convulsions which have dislocated them subsequently to their consolidation. These consolidated gravel beds are called conglomerates, breccias, or pudding stones; we find them among the transition rock, in the old red sandstone, in the mill-stone grits and coal-grits, in the lower members of the new red sandstone in the sand strata beneath the chalk, and in the gravel beds associated with the plastic clay, and interposed between the chalk and great London clay.

From the occurrence of the marine remains lately noticed, occupying, as they do, rocks spread over two-thirds of the surface of every part of our continents which have been explored, and rising to the highest situations, even to the loftiest summits of the Pyrenees, and still more elevated points on the Andes, it is an inevitable inference, that the greater part of those continents have not only been covered by, but have been formed of materials collected within the bosom of the ocean; that we inhabit countries which we may truly call *factas ex æquore terras.* The great and fundamental problem, therefore, of theoretical geology, is obviously to assign adequate causes for the change of level in this ocean, which has permitted these masses, which once formed the bottom of its channel, to rise in hills and mountains above its waves. The causes which it is possible to imagine are reducible to two general classes. First, The decrease of the absolute quantity of water. This must have resulted from causes entirely chemical, namely, the decomposition of some portion of the water, its constituents entering into new forms of combination; and its formation in the rocks formed beneath it. It is probable that these causes have operated to some degree, but it seems impossible to ascribe to them the very great difference of level for which we have to account.

The second class of possible causes is entirely mechanical; those, namely, which may have produced a change of relative level without any diminution of absolute quantity in the waters.

The causes of this kind which have been proposed are, first, The absorption of the waters into a supposed central cavity; but the now ascertained density of the earth (being greater than that which would result from an entirely solid sphere of equal magnitude of the most compact known rock) renders the existence of any such cavity very doubtful.

Secondly, A writer in the Journal of the Royal Institution, vol. ii. has proposed the very ingenious hypothesis, that a change of temperature of a few degrees will, from the unequal expansibility of the materials of land and water, sufficiently account for this change of level.

Thirdly, It has been ascribed to violent convulsions, which have either heaved up the present continents, or, which amounts to the same thing, (as the same relative change must have taken place in either view,) depressed the present channel of the ocean. If the violent elevation of the continent, or depression of the channel of the ocean, supposed in the last mentioned hypothesis, really took place, it must have left traces in the disturbed, contorted, and highly inclined position of the strata; and these disturbances must be the greatest where the change of level has been the greatest, *i. e.* in the neighbourhood of the loftiest mountains. Now this is actually the case.

In support of the hypothesis which ascribes an important part to volcanic agency in modifying the surface of our planet, the following, at least plausible, arguments might be adduced.

1. It must be kept in view, that the object is to assign an adequate cause for the undoubted fact of the emergence of the loftiest mountains of the present continent; and that when so mighty an effect is to be accounted for, the mind must be prepared to admit, without being startled, causes of a force and energy greatly exceeding those with which we are acquainted from actual observation.

2. The broken and disturbed state, and inclined position of the strata composing those continents, many of which must have been at the time of their original formation horizontal, indicate, as we have seen, that one at least of the causes operating to effect this great change of relative level between the land and waters, was the elevation of the former by mechanical force.

3. The only agent with which we are acquainted, whose operation bears any analogy to the effects above specified, is the volcanic energy which still occasionally forms new islands, and elevates new mountains.

4. Although these effects are now indeed partial and limited, yet there is certain proof that volcanic agency has formerly been much more active; the extinct volcanoes of the Rhine, Hungary, and Auvergne, as well as those which occupy so large a portion of Italy, where only one remains in activity, concur in proving, that at present we experience only the expiring efforts, as it were, of those gigantic powers which have once ravaged the face of nature.

5. If to this certain proof of the greater prevalence of volcanic convulsions in earlier, but still comparatively recent, periods of the history of our planet, we add the presumption that the trap rocks (so singularly intruded among the regular strata, and producing, where they traverse those strata, so precisely the effects of heat acting under compression, and so different in all their phenomena from formations decidedly aqueous,) were of volcanic origin, we shall find that scarcely a country exists, which has not been a prey to the ravages of this powerful principle. If, with many of the best geological observers, (Dr. M'Culloch, Von Buch, Necker, &c.) we incline to extend the same conclusions to granite rocks, a mass of volcanic power, clearly adequate to all the required effects, is provided.

6. The question will undoubtedly present itself, what is the source of volcanic action? And sufficient proof exists that this source is deeply seated beneath the lowest rocks with which our examination of the earth's surface makes us acquainted; for in Auvergne, the lavas have evidently been erupted from beneath the primitive rocks.

7. The very important recent discoveries with regard to the increased temperature noticed in descending deep mines, &c. by Messrs. Fox and Fourrier, will, if confirmed by further examination, prove, that some great source of heat exists beneath the earth's crust.

8. A degree of presumption may be thought to arise from these considerations, that the crust of the earth rests on a heated nucleus, the true source of volcanic energy. If this nucleus be in a fluid or viscous state, its undulations would readily account for the convulsions which have affected that crust, both in originally dislocating and elevating portions of its strata, and in the actual phenomena of earthquakes (of many of which phenomena no other hypothesis appears to offer a sufficient explanation,) while, at the same time, it would afford an adequate reason for the figure of the globe as a spheroid of rotation.

9. On this supposition, we should at once perceive a reason why the effects of the volcanic force may have been much more violent in earlier periods, while that mass of deposites which now covers the supposed volcanic nucleus, was but gradually forming over it, than at present; and we shall also find a reason for the higher temperature which many of the remains of both the animal and vegetable kingdoms, found in the strata of countries now too cold for the existence of their recent analogies, appear to indicate as having formerly prevailed.

10. It must be remembered, that one of the essential conditions of the theory above sketched is, the operation of volcanic agency beneath the pressure of an incumbent ocean; and that it does not, therefore, in any degree question the Neptunian origin of the majority of the rocks which have evidently been formed in the bosom of the ocean. With regard to the trap rocks alone, and perhaps the granitic, does it venture even to insinuate an opposite mode of formation?

Mr. Conybeare next shews, that the Wernerian generalization of the phenomena is too hasty. It supposes the basset edges of the strata to occupy levels successively lower and lower in proportion as they are of less ancient formation, and as they recede from the primitive chains, forming the edges of the basins in which they have been deposited. For if we compare the basset edges of the same strata on the opposite sides of the great European basin, (assuming the primitive ranges of our own island as one of its borders, and those of the Alpine chains as the other,) we shall find their level totally different.

The oolite, for instance, whose highest point with us is less than 1200 feet, attains a height of more than 4000 in the Jura chain, and in the mountains of the Tyrol has been observed by Mr. Buckland crowning some of the loftiest and most rugged summits of the Alps themselves. Again, if we compare the inclination of the strata at the edges of the basin, we shall find every thing but the supposed regular gradation, from a highly elevated to a horizontal position; on the contrary, we shall see the horizontal beds generally reposing at once upon the trun-

cated edges of those which lie at very considerable angles; and in place of the general conformity or parallelism which ought to prevail between the several formations, we shall observe, in many instances, appearances of the greatest irregularity in this respect; and these irregularities will be found to increase in approaching those chains which are the most elevated.

But if we suppose, that during the regular and gradual subsidence of the level of the ocean, in the Wernerian system, the continents were elevated by mechanical forces acting in a series of great convulsions, we shall perhaps obtain a nearer approximation to agreement with the actual phenomena, as deduced from observation. If these convulsions resulted from volcanic agency, we have already seen that there is every reason to believe this cause to have acted with most violence in the earliest periods; and this will sufficiently account for the greater derangement of the earlier rocks.

That the valleys have been, in many instances, entirely excavated by the agency of powerful aqueous currents, and in all, greatly modified by the same cause, seems as completely proved as the nature of the case can possibly admit. The same diluvial agency that has excavated the valleys, appears also to have swept off the superior strata from extensive tracts which they once covered. The proofs of this are to be found in insulated hills, or *outliers* of those strata, placed at considerable distances from their continuous range, with which they have every appearance of having been once connected; in the abrupt and truncated escarpments which form the usual termination of the strata, and in the very great quantity of their *debris*, scattered frequently over tracts far distant from those where they still exist *in situ*. This stripping off the *superstrata* is appropriately termed *denudation*.

The most important agency of this kind appears to have been exerted at an early period, and subsequently to the consolidation of all the strata, by an inundation which must have swept over them universally, and covered the whole surface with their *debris* indiscriminately thrown together, forming the last great geological change to which the surface of our planet appears to have been exposed.

To this general covering of water-worn *debris* derived from all the strata, the name of *diluvium* has been given, from the consideration of that great and universal catastrophe to which it seems most properly assignable. By this name it is intended to distinguish it from the partial *debris* occasioned by causes still in operation; such as the slight wear produced by the present rivers, the more violent action of torrents, &c. To the latter the name of *alluvium* has lately been appropriated. It does not seem possible to assign any single and uniform direction to the currents which have driven the diluvial *debris* before them; but they appear in every instance to have flowed (which indeed must of necessity be the case with the currents of subsiding waters,) as they were determined by the configuration of the adjoining country; from the mountains, that is, towards the lower hills and plains. As far as England is concerned, this principle will produce a general tendency to a direction from north-west towards south and east, greatly modified, however, by obvious local circumstances.

Another circumstance connected with the distribution of these travelled fragments is, that we often find them in masses of considerable size, accumulated in situations now separated by the intervention of deep valleys from the parent hills (if we may so speak,) whence we know them to have been torn. This appears to be a demonstrative proof that these intervening valleys must have been excavated subsequently to the transportation of these blocks; for though we can readily conceive how the agency of violent currents may have driven these blocks down an inclined plane, or if the *vis a tergo* were sufficient, along a level surface, or even up a very slight and gradual acclivity, it is impossible to ascribe to them the Sisyphean labour of rolling rocky masses, sometimes of many tons in weight, up the face of abrupt and high escarpments. The attention of geologists was first directed to this phenomenon by the discoveries of Saussure, who noticed one of its most striking cases—the occurrence of massive fragments torn from the primitive chains of the Alps, scattered at high levels on the escarpment of the opposite calcareous and secondary chains of the Jura, although between the two points, the deep valley containing the lake of Geneva is interposed. This phenomenon is one of very common occurrence. The Downs surrounding Bath (Hampton Down for example,) though abruptly scarped, and surrounded by valleys more than 600 feet deep, have yet on their very summits flints transported from the distant chalk hills. The simplest explanation of the fact will be, that these fragments were transported by the first action of the currents, before they had effected the excavation of the valleys, now cutting off all communication with the native rocks whence they were derived.

The organic remains of land animals dispersed through this diluvial gravel, must, with the greatest probability, be referred to the races extinguished by the great convulsion which formed that gravel; many of them are of species still inhabiting the countries where they are thus found; some of the species now inhabiting only other climates; and some few, of species and genera now entirely unknown.

To the same period we may ascribe the bones *of the same species with the above*, found in many caverns; but, in many of these instances, it is probable that some of the animals now found there, previously inhabited them as their dens. Professor Buckland appears to have proved satisfactorily, that this must have been the case in the remarkable instance of the cavern lately discovered near Kirby, Moorside, Yorkshire. Here the remains found in the greatest abundance are those of hyænas; with these are mingled fragments of various animals, from the mammoth to the water-rat. All the bones present evident traces of having been mangled and gnawed; and the whole are buried in a sediment of mud subsequently incrusted over by stalactical depositions. Professor Buckland's explanation is, that this cavern was occupied by the hyænas; who, according to the known habits of these animals, partially devoured even the bones of their prey, and dragged them for that purpose to their

dens; around their retreats, a similar *congeries* of mangled bones has been noticed by recent travellers. The proofs of these points, deduced from the circumstances of the cavern, the state of the bones, and the ascertained habits of the animals in question, appear to be decisive. The sediment in which the bones are imbedded, and the occurrence of the remains of the mammoths, and other species, only known (in these climates at least) in a fossil state, in the diluvial gravel, clearly refer their remains to the same era. Caverns containing bones of a similar class, the mammoth, the fossil species of a rhinoceros, &c. have been found near Swansea, at Hatton-hill, (on the Mendip chain in Somersetshire,) and near Plymouth.—*Rev. W. D. Conybeare, Introduction.*

The ancient history of the globe, which may be regarded as the *ultimate* object of geological researches, is undoubtedly one of the most curious subjects that can engage the attention of enlightened men. The lowest and most level parts of the earth, when penetrated to a very great depth, exhibit nothing but horizontal strata, composed of various substances, and containing almost all of them innumerable marine productions. Similar strata, with the same kind of productions, compose the hills even to a great height. Sometimes the shells are so numerous as to constitute the entire body of the stratum. They are almost every where in such a perfect state of preservation, that even the smallest of them retain their most delicate parts, their sharpest ridges, and tenderest processes. They are found in elevations far above the level of every part of the ocean, and in places to which the sea could not be conveyed by any presently existing cause. They are not merely enclosed in loose sand, but are often incrusted and penetrated on all sides by the hardest stones. Every part of the earth, every hemisphere, every continent, every island of any size, exhibits the same phenomenon. We are therefore forcibly led to believe, not only that the sea has at one period or another covered all our plains, but that it must have remained there for a long time, and in a state of tranquillity; which circumstance was necessary for the formation of deposites so extensive, so thick, in part so solid, and containing *exuviæ* so perfectly preserved. A nice and scrupulous comparison of the forms, contexture, and composition of these shells, and of those which still inhabit the sea, cannot detect the slightest difference between them. They have therefore once lived in the sea, and been deposited by it; the sea consequently must have rested in the places where the disposition has taken place. Hence it is evident, that the basin or reservoir containing the sea has undergone some change, either in extent, situation, or both.

The traces of revolutions, become still more apparent and decisive when we ascend a little higher, and approach nearer to the foot of the great chain of mountains. There are still found many beds of shells; some of these are even larger and more solid; the shells are quite as numerous, and as entirely preserved; but they are not of the same species with those which were found in the less elevated regions. The strata which contain them are not so generally horizontal; they have various degrees of inclination, and are sometimes situated vertically. While in the plains and low hills it was necessary to dig deep in order to detect the succession of the strata, here we perceive them by means of the valleys, which time or violence has produced, and which disclose their edges to the eye of the observer.

Thus the sea, previous to the formation of the horizontal strata, had formed others, which by some means have been broken, lifted up, and overturned in a thousand ways. But the sea has not always deposited stony substances of the same kind. It has observed a regular succession as to the nature of its deposites; the more ancient the strata are, so much the more uniform and extensive are they; and the more recent they are, the more limited are they, and the more variation is observed in them at small distances. Thus the great catastrophes which have produced revolutions in the basins of the sea, were preceded, accompanied, and followed by the changes in the nature of the fluid, and of the substances which it held in solution; and when the surface of the seas came to be divided by islands and projecting ridges, different changes took place in every separate basin.

These irruptions and retreats of the sea have neither been slow nor gradual: most of the catastrophes which have occasioned them have been sudden; and this is easily proved, especially with regard to the last of them, or the Mosaic deluge, the traces of which are very conspicuous. In the northern regions it has left the carcasses of some large quadrupeds, which the ice had arrested, and which are preserved even to the present day, with their skin, their hair, and their flesh. If they had not been frozen as soon as killed, they must have been quickly decomposed by putrefaction. But this perpetual frost could not have taken possession of the regions which these animals inhabited, except by the same cause which destroyed them: this cause must therefore have been as sudden as its effect. The two most remarkable phenomena of this kind, and which must for ever banish all idea of a slow and gradual revolution, are the rhinoceros, discovered in 1771 on the banks of the *Vilhoui*, and the elephant, recently found by Mr. Adams near the mouth of the *Sena*. This last retained its flesh and skin, on which was hair of two kinds; one short, fine, and crisped, resembling wool, and the other like bristles. The flesh was still in such high preservation, that it was eaten by dogs. Every part of the globe bears the impress of these great and terrible events so distinctly, that they must be visible to all who are qualified to read their history in the remains which they have left behind.—*See Cuvier's Theory of the Earth.*

GEOMETRY is that branch of mathematics which treats of the properties of extension and figure. The name is derived from the Greek term γεωμετρια, which properly signifies the science of land-measuring, as it was the necessity of measuring the land that first gave occasion to contemplate the principles and rules of this art, which has since been extended to numberless other speculations; insomuch that, together with arithmetic, geometry forms now the chief foundation of all the mathematics.

Herodotus and Proclus ascribe the inven

tion of geometry to the Egyptians, and assert that the annual inundations of the Nile gave occasion to it; for those waters bearing away the bounds and landmarks of estates and farms, covering the face of the ground uniformly with mud, the people, say they, were obliged every year to distinguish and lay out their lands by the consideration of their figure and quantity; and thus by experience and habit they formed a method or art, which was the origin of geometry.

Geometry is distinguished into theoretical or speculative, and practical.

Theoretical or speculative geometry treats of the various properties and relations in magnitudes, demonstrating the theorems, &c.

Practical geometry, is that which applies those speculations and theorems to particular uses in the solution of problems, and in the measurements in the ordinary concerns of life.

Speculative geometry again may be divided into elementary and sublime.

Elementary or common geometry, is that which is employed in the consideration of right lines and plane surfaces, with the solids generated from them.

And the higher or sublime geometry, is that which is employed in the consideration of curve lines, conic sections, and the bodies formed of them. This part has been chiefly cultivated by the moderns, by help of the improved state of algebra, and the modern analysis or fluxions.

We shall now proceed to give the principles of practical geometry, beginning with

Definitions.

1. A mathematical point has neither length, breadth, nor thickness. From this definition it may be easily understood that a mathematical point cannot be seen nor felt; it can only be imagined.

What is commonly called a point, as a small dot made with a pencil or pen, or the point of a needle, is not in reality a mathematical point; for however small such a dot may be, yet if it be examined with a magnifying glass, it will be found to be an irregular spot, of a very sensible length and breadth: and our not being able to measure its dimensions with the naked eye, arises only from its smallness.

2. A line is length without breadth or thickness. What was said above of a point, is also applicable to the definition of a line. A line therefore can only be imagined. The ends of a line are points.

3. Parallel lines are such as always keep at the same distance from each other, and which, if prolonged ever so far, would never meet. See Plate XIX, fig. 1.

4. A right line is what is commonly called a straight line, or one that tends every where the same way.

5. A curve is a line which continually changes its direction between its extreme points.

6. An angle is the inclination or opening of two lines meeting in a point, fig. 2.

7. The lines AB and BC, which form the angle, are called the legs or sides; and the point B, where they meet, is called the vertex of the angle, or the angular point. An angle is sometimes expressed by a letter placed at the vertex, as the angle B, fig. 2; but most commonly by three letters, observing to place in the middle the letter at the vertex, and the other two are those at the end of each leg, as the angle ABC.

8 When one line stands upon another, so as not to lean more to one side than to another, both the angles which it makes with the other are called right angles, as the angles ABC and ABD, fig. 3; and all right angles are equal to each other, being all equal to 90°; and the line AB is said to be perpendicular to CD.

Beginners are very apt to confound the terms perpendicular, and plumb or vertical line. A line is vertical when it is at right angles to the plane of the horizon, or level surface of the earth, or to the surface of water, which is always level. The sides of a house are vertical. But a line may be perpendicular to another, whether it stands upright, or inclines to the ground, or even if it lies flat upon it, provided only that it makes the two angles formed by meeting with the other line equal to each other; as for instance, if the angles ABC and ABD be equal, the line AB is perpendicular to CD whatever may be its position in other respects.

9. When one line BE (fig. 3.) stands upon another, CD, so as to incline, the angle EBC, which is greater than a right angle, is called an obtuse angle; and that which is less than a right angle is called an acute angle, as the angle EBD.

10. Two angles which have one leg in common, as the angles ABC and ABE, are called contiguous angles, or adjoining angles; those which are produced by the crossing of two lines, as the angles EBD and CBF, formed by CD and EF, crossing each other, are called opposite or vertical angles.

11. A figure is a bounded space, and is either a surface or a solid.

12 A superficies, or surface, has length and breadth only. The extremities of a superficies are lines.

13. A plane, or plane surface, is that which is every where perfectly flat and even, or which will touch every part of a straight line, in whatever direction it may be laid upon it. The top of a marble slasb, for instance, is an example of this, which a straight edge will touch in every point, so that you cannot see light any where between.

14. A curved surface is that which will not coincide with a straight line in any part. Curved surfaces may be either convex or concave.

15. A convex surface is when the surface rises up in the middle; as, for instance, a part of the outside of a globe,

16. A concave surface is when it sinks in the middle, or is hollow, and is the contrary to convex.

A surface may be bounded either by straight lines, curved lines, or both these.

17. Every surface bounded by straight lines only is called a polygon. If the sides are all equal, it is called a regular polygon. If they are unequal, it is called an irregular polygon. Every polygon, whether equal or unequal, has the same number of sides as angles, and they are denominated sometimes according to the number of sides, and sometimes from the number of angles they contain. Thus, a figure of three

sides is called a triangle, and a figure of four sides a quadrangle.

A pentagon is a polygon of five sides: a hexagon has six sides; a heptagon seven sides; an octagon eight sides; a nonagon nine sides; a decagon ten sides; an undecagon eleven sides: a duodecagon twelve sides.

When they have a greater number of sides, it is usual to call them polygons of 13 sides, of 14 sides, and so on.

Triangles are of different kinds, according to the lengths of their sides.

18. An equilateral triangle has all its sides equal, as ABC, fig. 4.

19. An isosceles triangle has two equal sides, as DEF, fig. 5.

20. A scalene triangle has all its sides unequal, as GHI, fig. 6.

Triangles are also denominated according to the angles they contain.

21. A right-angled triangle is one that has in it a right-angle, as ABC, fig. 7.

22. A triangle cannot have more than one right angle. The side opposite to the right angle B, as AC, is called the hypothenuse, and is always the longest side.

23. An obtuse-angled triangle has one obtuse angle, as fig. 8.

24. An acute-angled triangle has all its angles acute, as fig. 4.

25. An isosceles, or a scalene triangle, may be either right angled, obtuse, or acute.

26. Any side of a triangle is said to subtend the angle opposite to it: thus AB (fig. 7.) subtends the angle ACB.

27. If the side of a triangle be drawn out beyond the figure, as AD (fig. 8.) the angle A or CAB, is called an internal angle, and the angle CAD, or that without the figure, an external angle.

28. A quadrangle is also called a quadrilateral figure. They are of various denominations, as their sides are equal or unequal, or as all their angles are right-angles or not.

29. Every four-sided figure whose opposite sides are parallel, is called a parallelogram. Provided that the sides opposite to each other be parallel, it is immaterial whether the angles are right or not. Figs. 9, 10, 11, and 12, are all parallelograms.

30. When the angles of a parallelogram are all right angles, it is called a rectangular parallelogram, or a rectangle, as figs. 11 and 12.

31. A rectangle may have all its sides equal, or only the opposite sides equal. When all its sides are equal, it is called a square, as fig. 12.

32. When the opposite sides are parallel, and all the sides equal to each other, but the angles not right angles, the parallelogram is called a rhombus, as fig. 10.

33. A parallelogram having all its angles oblique, and only its opposite equal, is called a rhomboid, as fig. 9.

34. When a quadrilateral, or four-sided figure, has none of its sides parallel, it is called a trapezium, as fig. 13, consequently every quadrangle, or quadrilateral, which is not a parallelogram, is a trapezium,

35. A trapezoid has only one pair of its sides parallel, as fig. 14.

36. A diagonal is a right line drawn between any two angles that are opposite in a polygon, as IK, fig. 15. In parallelograms the diagonal is sometimes called the diameter, because it passes through the centre of the figure.

37. Complements of a parallelogram. If any point, as E (fig. 15.) be taken in the diagonal of a parallelogram, and through that point two lines are drawn parallel to the sides, as AB, CD, it will be divided into four parallelograms, D, D, L, F, G, G. The two divisions, L, F, through which the diameter does not pass, are called the complements.

38. Base of a figure, is the side on which it is supposed to stand erect, as AD and CD, fig. 16.

39. Altitude of a figure is its perpendicular height from the base to the highest part, as EF fig. 16.

40. Area of a plane figure, or other surface, means the quantity of space contained within its boundaries, expressed in square feet, yards, or any other superficial measure.

41. Similar figures are such as have the same angles, and whose sides are in the same proportion, as fig. 17.

42. Equal figures are such as have the same area or contents.

43. A circle is a plane figure, bounded by a curve line returning into itself, called its circumference, ABCD (fig. 18), every where equally distant from a point E within the circle which is called the centre.

44. The radius of a circle is a straight line drawn from the centre to the circumference, as EF, (fig. 18). The radius is the opening of the compass when a circle is described; and consequently all the radii of a circle must be equal to each other.

45. A diameter of a circle is a straight line drawn from one side of the circumference to the other through the centre, as CB (fig. 18.) Every diameter divides the circle into two equal parts.

46. A segment of a circle is a part of a circle cut off by a straight line drawn across it. This straight line is called the chord. A segment may be either equal to, greater, or less than, a semicircle, which is a segment formed by the diameter of the circle, as CEB, and is equal to half the circle.

47. A tangent is a strait line drawn so as just to touch a circle without cutting it, as GH (fig. 18.) The point A, where it touches the circle, is called the point of contact. And a tangent cannot touch a circle in more points than one.

48. A sector of a circle is a space comprehended between two radii and an arc, as IK, (fig. 19.)

49. The circumference of every circle, whether great or small, is supposed to be divided into 360 equal parts, called degrees· and every degree into 60 parts, called minutes, and every minute into 60 seconds. To measure the inclination of lines to each other, or angles, a circle is described round the angular point as a centre, as IK, (fig. 19;) and according to the number of degrees, minutes, and seconds, cut off by the sides of the angle, so many degrees, minutes, and seconds, it is said to contain. Degrees are marked by $^\circ$, minutes by $'$, and seconds by $''$; thus an angle of 48 degrees, 15 minutes, and 7 seconds, is written in this manner, $48^\circ\ 15'\ 7''$

50. A solid is any body that has length,

breadth, and thickness: a book, for instance, is solid, so is a sheet of paper; for though its thickness is very small, yet it has some thickness. The boundaries of a solid are surfaces.

51. Similar solids are such as are bounded by an equal number of similar planes.

52. A prism is a solid, of which the sides are parallelograms, and the two ends or bases are similar polygons, parallel to each other. Prisms are denominated according to the number of angles, in the base, triangular prisms, quadrangular, heptangular, and so on, as figs. 20, 21, 22, 23. If the sides are perpendicular to the plane of the base, it is called an upright prism; if they are inclined, it is called an oblique prism.

53. When the base of a prism is a parallelogram, it is called a parallelopipedon, as figs. 22 and 23. Hence a parallelopipedon is a solid terminated by six parallelograms.

54. When all the sides of a parallelopipedon are squares the solid is called a cube, as fig. 23.

55. A rhomboid is an oblique prism, whose bases are parallelograms (fig. 24.)

56. A pyramid (figs. 25 and 26) is a solid bounded by, or contained within, a number of planes, whose base may be any polygon, and whose faces are terminated in one point, B, commonly called the vertex of the pyramid.

57. When the figure of the base is a triangle, it is called a triangular pyramid; when the figure of the base is a quadrilateral, it is called a quadrilateral pyramid, &c.

58. A pyramid is either regular or irregular, according as the base is regular or irregular.

59. A pyramid is also right or upright, or it is oblique. It is right, when a line drawn from the vertex to the centre of the base, is perpendicular to it, as fig. 25: and oblique, when this line inclines, as fig. 26.

60. A cylinder is a solid (figs. 27. and 28,) generated or formed by the rotation of a rectangle about one of its sides, supposed to be at rest: this quiescent side is called the axis of the cylinder. Or it may be conceived to be generated by the motion of a circle, in a direction perpendicular to its surface, and always parallel to itself.

61. A cylinder is either right or oblique, as the axis is perpendicular to the base or inclined.

62. Every section of a right cylinder taken at right angles to its axis, is a circle; and every section taken across the cylinder, but oblique to the axis, is an ellipsis

63. A circle being a polygon of an infinite number of sides, it follows, that the cylinder may be conceived as a prism, having such a polygon for bases.

64. A cone is a solid, (figs. 29 and 30,) having a circle for its base, and its sides a convex surface, terminating in a point A, called the vertex, or apex of the cone. It may be conceived to be generated by the revolution of a right-angled triangle about its perpendicular.

65. A line drawn from the vertex to the centre of the base is the axis of the cone.

66. When this line is perpendicular to the base the cone is called an upright, or right cone; but when it is inclined it is called an oblique cone.

67. If it be cut through the axis from the vertex to the base, the section will be a triangle.

68. If a right cone be cut by a plane at right angles to the axis, the section will be a circle.

69. If it be cut oblique to the axis, and quite across from one side to the other, the section will be an ellipsis, as fig. 31. A section of a cylinder made in the same manner is also an ellipsis; and that is easily conceived: but it does not appear so readily that the oblique section of a cone is an ellipsis: it is frequently imagined that it will be wider at one end than the other, or what is called an oval, which is the shape of an egg. But that this is a mistake, any one may convince himself by making a cone, and cutting it across obliquely; it will be then seen that the section, in whatever direction it is taken, is a regular ellipsis; and this is the case, whether the one be right or oblique, except only in one case in the oblique cone; which is when the section is taken in a particular direction, which is called sub-contrary to its base.

70. When the section is made parallel to one of the sides of the cone, as fig. 32, the curve ABC, which bounds the section, is called a parabola.

71. When the section is taken parallel to the axis as fig. 33, the curve is called an hyperbola.

These curves, which are formed by cutting a cone in different directions, have various properties, which are of great importance in astronomy, gunnery, perspective and many other sciences.

72. A sphere is a solid, terminated by a convex surface, every point of which is at an equal distance from a point within, called the centre, fig. 34.

73. It may be conceived to be formed by making a semicircle revolve round its diameter. The diameter of the semicircle round which it revolves, is called the axis of the sphere.

74. The ends of the axis are called poles.

75. Any line passing through the centre of the sphere, and terminated by the circumference, is a diameter of the sphere.

76. Every section of a sphere is a circle; every section taken through the centre of the sphere is called a great circle, as AB, fig. 34; every other is a lesser circle, as CD.

77. Any portion of a sphere cut off by a plane is called a segment; and when the plane passes through the centre, it divides the sphere into two equal parts, each of which is called a hemisphere.

78. A spheroid is a solid (fig. 35,) generated by the rotation of a semi-ellipsis about the transverse or conjugate axis; and the centre of the ellipsis is the centre of the spheroid.

79. The line about which the ellipsis revolves is called the axis. If the spheriod be generated about the conjugate axis of the semi-ellipsis, it is called a prolate spheroid.

80. If the spheroid be generated by the semi-ellipsis by revolving about the transverse axis, it is called an oblong spheroid.

81. Every section of a spheriod is an ellipsis, except when it is perpendicular to that axis about which it is generated; in which case it is a circle.

82. All sections of a spheroid parallel to each other, are similar figures.

A frustum of a solid, means a piece cut off from the solid by a plane passed through it, usually parallel to the base of the solid, as the frustum of a cone, a pyramid, &c.

There are a lower and an upper frustum, according as the piece spoken of does or does not contain the base of the solid.

83. Ratio is the proportion which one magnitude bears to another of the same kind, with respect to quantity, and is usually marked thus, A : B.

Of these the first is called the antecedent, and the second the consequent.

84. The measure or quantity of a ratio is conceived by considering what part of the consequent is the antecedent; consequently it is obtained by dividing the consequent by the antecedent.

85. Three magnitudes or quantities, A, B, C, are said to be proportional, when the ratio of the first to the second is the same as that of the second to the third. Thus 2, 4, 8, are proportional; because 4 is contained in 8 as many times as 2 is in 4.

86. Four quantities, A, B, C, D, are said to be proportional when the ratio of the first A to the second B is the same as the ratio of the third C to the fourth D. It is usually written A : B :: C : D, or, if expressed in numbers, 2 : 4 :: 8 : 16.

87. Of three proportional quantities, the middle one is said to be a mean proportional between the other two: and the last a third proportional to the first and second.

88. Of four proportional quantities, the last is said to be a fourth proportional to the other three, taken in order.

89. Ratio of equality is that which equal numbers bear to each other.

90. Inverse ratio is when the antecedent made the consequent, and the consequent the antecedent. Thus, if 1 : 2 :: 3 : 6; then inversely, 2 : 1 :: 6 : 3.

91. Alternate proportion is when antecedent compared with antecedent, and consequent with consequent. Thus, if 2 : 1 :: 6 : 3; then by alternation 2 : 6 :: 1 : 3.

92. Proportion by composition is when the antecedent and consequent, taken as one quantity, are compared either with the consequent or with the antecedent. Thus, if 2 : 1 :: 6 : 3; then by composition 2 + 1 : 1 :: 6 + 3 : 3; and 2 + 1 : 2 :: 6 + 3 : 6.

93. Divided proportion is when the difference of the antecedent and consequent is compared either with the consequent or with the antecedent. Thus, if 3 . 1 :: 12 : 4; then by division, 3 − 1 : 1 :: 12 − 4 : 4, and 3 − 1 : 3 :: 12 −4 : 12.

94. Continued proportion is when the first is to the second; as the second to the third; as the third to the fourth; as the fourth to the fifth; and

95. Compound ratio is formed by the multiplication of several antecedents and the several consequents of ratios together, in the following manner:

If A be to B as 3 to 5, B to C as 5 to 8, and C to D as 8 to 6; then A will be to D, as $\frac{3 \times 5 \times 8}{5 \times 8 \times 6} = \frac{120}{240}$ that is A . D :: 1 : 2.

96. *Bisect* means to divide any thing into two equal parts.

97. *Trisect* is to divide any thing into three equal parts.

98. *Inscribe*, to draw one figure within another, so that all angles, of the inner figure touch either the angles, sides, or plane, of the external figure.

99. *Circumscribe*, to draw a figure round another, so that either the angles, sides, or planes of the cirsumscribed figure, touch all the angles of the figure within it.

100. Rectangle under any two lines, means a rectangle which has two of its sides equal to one of the lines, and two of them equal to the other. Also the rectangle under AB, CD, means AB × CD.

101. Scales of equal parts. A scale of equal parts is only a straight line, divided into any number of equal parts at pleasure. Each part may represent any measure required, as an inch, a foot, a yard, &c. One of these is generally subdivided into parts of the next denomination, or into tenths or hundredths. Scales may be constructed in a variety of ways. The most usual manner is to make an inch, or some aliquot part of an inch to represent a foot; and then they are called inch-scales, three-quarter-inch scales, half-inch scales, quarter-inch scales, &c. They are usually drawn upon ivory or boxwood.

102. An axiom is a manifest truth, not requiring any demonstration.

103. Postulates are things required to be granted true, before we proceed to demonstrate a proposition.

104. A proposition is when something is either proposed to be done, or to be demonstrated, and is either a problem or a theorem.

105. A problem is when something is proposed to be done, as some figure to be drawn.

106. A theorem is when something is proposed to be demonstrated or proved.

107. A lemma is when a premise is demonstrated in order to render the thing in hand the more easy.

108. A corollary is an inference drawn from the demonstration of some proposition.

109. A scholium is when some remark or observation is made upon something mentioned before.

Geometrical Problems.

Prob. 1. To divide a given line AB; Plate XX. into two equal parts.

From the points A and B as centres, and with any opening of the compasses greater than half AB, describe arches, cutting each other in c and d. Draw the line c d; and the point E, where it cuts AB, will be the middle required.

Prob. 2. To raise a perpendicular to a given line AB, from a point given at C.

Case 1. When the given point is near the middle of the line on each side of the point C. Take any two equal distances, C d and C e; from d, and e, with any radius or opening of the compasses greater than C d, or C e, describe two arcs cutting each other in f. Lastly, through the points f, C, draw the line f C, and it will be the perpendicular required.

Case 2. When the point is at, or near, the end of the line. Take any point d, above the line, and with the radius or distance d C,

describe the arc e C f, cutting AB in e and C. Through the centre d, and the point e, draw the line e d f, cutting the arc e C f in f. Through the points f, C, draw the line f C, and it will be the perpendicular required.

Prob. 3. From a given point f, to let fall a perpendicular upon a given line AB.

From the point f, with any radius, describe the arc d e, cutting AB in e and d. From the points e d, with the same or any other radius, describe two arcs, cutting each other in g, Through the points f and g, draw the line f g, and f C will be the perpendicular required.

Prob. 4. To make an angle equal to another angle which is given, as to B b.

From the point B, with any radius, describe the arc a b, cutting the legs B a, B b, in the points a and b. Draw the line D e, and from the point D, with the same radius as before, describe the arc e f, cutting D e in e. Take the distance b a, and apply it to the arc e f, from e to f. Lastly, through the points D, f, draw the line D f, and the angle e D f will be equal to the angle b B a, as was required.

Prob. 5. To divide a given angle, ABC, into two equal angles.

From the point B. with any radius describe the arc AC. From A and C with the same, or any other radius describe arcs cutting each other in d. Draw the line B d, and it will bisect the angle ABC, as was required.

Prob. 6. To lay down an angle of any number of degrees.

There are various methods of doing this One is by the use of an instrument called a protractor, which is a semicircle of brass, having its circumference divided into degrees. Let AB be a given line, and let it be required to draw from the angular point A, a line making with AB any number of degrees, suppose 50. Lay the straight side of the protractor along the line AB, and count 50° from the end B of the semicircle ; at C, which is 50° from B. mark ; then, removing the protractor, draw the line AC, which makes with AB the angle required. Or it may be done by a line. usually drawn upon scales, called a line of chords.

Prob. 7. Through a given point C, to draw a line parallel to a given line AB.

Case 1. Take any point d, in AB: upon d and C, with the distance C d, describe two arcs, e C, and d f, cutting the line AB in e and d. Make d f equal to e C; through C and f draw C f and it will be the line required.

Case 2. When the parallel is to be at a given distance from AB. From any two points, c and d, in the line AB, with a radius equal to the given distance, describe the arcs e and f; draw the line CB to touch those arcs without cutting them, and it will be parallel to AB, as was required.

Prob. 8. To divide a given line AB, into any proposed number of equal parts.

From A, one end of the line, draw A c, making any angle with AB; and from B, the other end, draw B d, making the angle AB d equal to BA c. In each of these lines, A c, B d, beginning at A and B, set off as many equal parts of any length as AB is to be divided into. Join the points C 5, 46, 57, and AB will be divided as required.

Prob. 9. To find the centre of a given circle, or of any one already described. Draw any chord, AB, and bisect it with the perpendicular CD. Bisect CD with the diameter EF. and the intersection O will be the centre required.

Prob. 10. To draw a tangent to a given circle that shall pass through a given point A.

From the centre O, draw the radius OA. Through the point A, draw DE perpendicular to OA, and it will be the tangent required.

Prob. 11. To draw a tangent to a circle, or any segment of a circle ABC, through a given point B, without making use of the centre of the circle.

Take any two equal divisions upon the circle from the given point B, towards d and e, and draw the chord e B. Upon B, as a centre, with the distance B d, describe the arc f d g, cutting the chord e B in f. Make d g equal to d f; through g draw g B, and it will be the tangent required.

Prob. 12. Given three points, A, B, C, not in a straight line, to describe a circle that shall pass through them.

Bisect the lines AB, BC, by the perpendiculars a d, b d, meeting at d. Upon d, with the distance d A, d B, describe ABC, and it will be the required circle.

Prob. 13. To describe the segment of a circle to any length AB, and height CD.

Bisect AB by the perpendicular D g, cutting AB in c. From c make c D on the perpendicular equal to CD. Draw AD, and bisect it by a perpendicular e f, cutting D g in g. Upon g the centre, describe ADB, and it will be the required segment.

Prob. 14. In any given triangle to inscribe a circle.

Bisect any two angles, A and C, with the lines AD and DC. From D the point of intersection, let fall the perpendicular DE ; it will be the radius of the circle required.

Prob. 15. In a given square, to describe a regular octagon.

Draw the diagonals AC and BD, intersecting at e. Upon the points A, B, C, D, as centres, with a radius e C, describe the arcs k e n, m e g. f e i, &c. Join f n, m h, k i, l g, and it will be the required octagon.

Prob. 16. In a given circle. to describe any regular polygon.

Divide the circumference into as many parts as there are sides in the polygon to be drawn, and join the points of division.

Prob. 17. Upon a given line AB, to construct an equilateral triangle.

Upon the points A, and B, with a radius equal to AB, describe arches cutting each other at C. Draw AC and BC, and ABC will be the triangle required.

Prob. 18 To make a trapezium equal and similar to a given trapezium ABCD.

Divide the given trapezium ABCD into two triangles by the diagonal DB. Make EF equal to AB ; upon EF construct the triangle EFH, whose sides shall be respectively equal to those of the triangle ABD by the last problem. Upon HF, which is equal to DB, construct the triangle HFG, whose sides are respectively equal to DBC ; then EFGH will be the trapezium required.

By the help of this problem any plan may be copied ; as every figure however irregular, may be divided into triangles. Upon this the practice of land-surveying and making plans of estates, is founded.

Prob. 19. To make a square equal to two given squares. Make the sides DE and DF of the two given squares A and B, form the sides of a right-angled triangle FDE; draw the hypothenuse FE; on it describe the square EFGH, and it will be the square required.

Prob. 20. Between two given lines, AB and CD, to find a mean proportional.

Draw the right line EG, in which make EF equal to AB, and FG equal to CD. Bisect EG in H, and with HE or HG, as radius, describe the semicircle EIG. From F draw FI perpendicular to EG, cutting the circle in I; and IF will be the mean proportional required.

With respect to the application of geometry to its pristine intent, namely, the measurement of land, we must refer our readers to SURVEYING; under which head it will be found practically exemplified.

GEORGIC, a poetical composition upon the subject of husbandry, containing rules therein, put into a pleasing dress, and set off with all the beauties and embellishments of poetry.

GERANIUM, *crane's-bill*, a genus of the decandria order, in the monadelphia class of plants, and in the natural method ranking under the 14th order, gruinales. Its characters are these: the flower has a permanent empalement, composed of five small oval leaves, and five oval or heart-shaped petals, spreading open, which are in some species equal, and in others the upper two are much larger than the three lower. It has ten stamina, alternately longer than each other, but shorter than the petals, and terminated by oblong summits. In the bottom of the flower is situated a five-cornered germen, which is permanent. The flower is succeeded by five seeds, each being wrapped up in the husk of the beak, where they are twisted together at the point, so as to form the resemblance of a stork's beak. There are 32 species.

GERMINATION. When a seed is placed in a situation favourable to vegetation, it very soon changes its appearance; the radicle is converted into a root, and sinks into the earth; the plumula rises above the earth, and becomes the trunk or stem. When these changes take place, the seed is said to germinate; the process itself has been called germination, which does not depend upon the seed alone; something external must affect it. Seeds do not germinate equally and indifferently in all places and seasons, they require moisture and a certain degree of heat, and every species of plant seems to have a degree of heat peculiar to itself, at which its seeds begin to germinate; air also is necessary to the germination of seeds; it is for want of air that seeds which are burried at a great depth either thrive but indifferently, or do not rise at all. They frequently preserve, however, their germinating virtues for many years within the bowels of the earth; and it is not unusual, upon a piece of ground being newly dug to a considerable depth, to observe it soon after covered with several plants which had not been seen there in the memory of man. Light is supposed to be injurious to the process, which affords a reason for covering seeds with the soil in which they are to grow, and for carrying on the business of malting in darkened apartments; malting being nothing more than germination. converted with a particular view

GEROPOGON, a genus of the syngenesia polygamia æqualis class and order. There are three species, all plants of Italy, having the same habit with the tragopogons.

GESNERIA, a genus of the angiospermia order, in the didynamia class of plants, and in the natural method ranking under the 40th order, personatæ. There are 12 species, herbs and shrubs of the West Indies.

GETHYLLIS, a genus of the monogynia order, in the dodecandria class of plants, and in the natural method ranking under the 9th order, spathaceæ. There are four species, herbs of the Cape.

GIANT'S *causeway*, a vast collection of a black kind of marle, called basaltes, in the county of Antrim, in Ireland. See BASALTES.

GIBBOUS, in astronomy, a term used in reference to the enlightened parts of the moon, whilst she is moving from the first quarter to the full, and from the full to the last quarter: for all that time the dark part appears horned; and the light one convex or gibbous.

GIFT, in law, a transferring the property in a thing from one to another without a valuable consideration; for to transfer any thing upon a valuable consideration, is a contract or sale. He who gives any thing is called the donor, and he to whom is given is called the donee. By the common law all chattels, real or personal, may be granted or given without deed, except in some special cases, and a free gift is good without a consideration, if not to defraud creditors. But no leases, estates, or interests, either of freehold or term of years, on any uncertain interest, not being copyhold or customary interest of, in, to, or out of any messuages, manors, lands, tenements, or hereditaments, shall at any time be assigned, granted, or surrendered, unless it be by deed or note in writing, signed by the party so assigning, granting, or surrendering the same, or their agents thereunto lawfully authorized by writing; or by act and operation of law.

GILDING. The art of covering the surfaces of bodies with gold. The gold prepared for painting is called shell-gold or gold-powder, and may be obtained by amalgamating one part of gold with eight of quicksilver, and afterwards evaporating the latter, which leaves the gold in the form of powder; or the metal may be reduced to powder by mechanical trituration. For this purpose, gold leaf must be ground with honey or strong gum-water for a long time; and when the powder is sufficiently fine, the honey or gum may be washed off with water

For gold gilding by friction, a fine linen rag is steeped in a saturated solution of gold, till it has entirely imbibed the liquor; this rag is then dried over a fire, and afterward burned to tinder. When any thing is to be gilded, it must be previously well burnished; a piece of cork is then to be dipped, first into a solution of salt in water, and afterward into the black powder; and the piece, after it is burnished, rubbed with it.

For water gilding, the solution of gold may be evaporated till it is of an oily consistence, suffered to crystallize, and the crystals dissolved in water be employed instead of the acid solution. If this be copiously diluted with alcohol, a piece of clean iron will be gilded by being steeped therein Or add to the solution

about three times its quantity of sulphuric ether, which will soon take up the nitro-muriate of gold, leaving the acid colourless at the bottom of the vessel, which must then be drawn off. Steel dipped into the ethereal solution for a moment, and instantly washed in clean water, will be completely and beautifully covered with gold. The surface of the steel must be well polished, and wiped very clean.

For the method called Grecian gilding, equal parts of sal ammoniac and corrosive sublimate are dissolved in nitric acid, and a solution of gold is made in this menstruum: upon this the solution is somewhat concentrated, and applied to the surface of silver, which becomes quite black; but, on being exposed to a red heat, it assumes the appearance of gilding.

The method of gilding silver, brass, or copper, by an amalgam, is as follows: Eight parts of mercury, and one of gold, are incorporated together by heating them in a crucible. As soon as the gold is perfectly dissolved, the mixture is poured into cold water, and is then ready for use.

Before the amalgam can be laid upon the surface of the metal, this last is brushed over with dilute aqua fortis, in which it is of advantage that some mercury may have been dissolved. Some artists then wash the metal in fair water, and scour it a little with fine sand, previous to the application of the gold; but others apply it to the metal while still wet with the aquafortis. But in either case the amalgam must be laid on as uniformly as possible, and spread very evenly with a brass-wire brush, wetted occasionally with fair water. The piece is then laid upon a grate, over a charcoal fire, or in a small oven or furnace adapted to this purpose. The heat drives off the mercury, and leaves the gold behind. Its defects are then seen, and may be remedied by successive applications of more amalgam, and additional application of heat. The expert artists, however, make these additional applications while the piece remains in the furnace, though the practice is said to be highly noxious on account of the mercurial fumes. After this it is rubbed with gilders' wax, which may consist of four ounces of bees' wax, one ounce of verdigris, and one ounce of sulphate of copper; then expose it to a red heat, which burns off the wax; and, lastly, the work is cleared with the scratch brush, and burnished, if necessary, with a steel tool. The use of the wax seems to consist merely in covering defects, by the diffusion of a quantity of red oxide of copper, which is left behind after the burning.

The gilding of iron by mere heat is performed by cleaning and polishing its surface, and then heating it till it has acquired a blue colour. When this has been done, the first layer of gold leaf is put on, slightly burnished down, and exposed to a gentle fire. It is usual to give three such layers, or four at the most, each consisting of a single leaf for common works, or two for extraordinary ones. The heating is repeated at each layer, and last of all the work is burnished.

The gilding of buttons is done in the following way: When the buttons, which are of copper, are made, they are dipped into dilute nitric acid to clean them, and then burnished with a hard black stone. They are then put into a nitric solution of mercury, and stirred about with a brush till they are quite white. An amalgam of gold and mercury is then put into an earthen vessel with a small quantity of dilute nitric acid, and in this mixture the buttons are stirred, till the gold attaches to their surface. They are then heated over the fire, till the mercury begins to run, when they are thrown into a large cap made of coarse wool and goats' hair, and in this they are stirred about with a brush. The mercury is then volatilized by heating over the fire in a pan, to the loss of the article, and injury of the workmen's health; though the greater part might be recovered, with less injury to the operators.

Painting with gold upon porcelain or glass is done with the powder of gold, which remains behind after distilling the aqua regia from a solution of that metal. It is laid on with borax and gum water, burned in, and polished. The gilding of glass is commonly effected by covering the part with a solution of borax, and applying gold leaf upon it, which is afterwards fixed by burning.

Gilding in oil is performed by means of a paint sold under the name of gold size. It consists of drying oil, (that is to say, linseed oil boiled upon litharge,) and mixed with yellow ochre. It is said to improve in its quality by keeping. This is laid upon the work; and when it has become so dry as to adhere to the fingers without soiling them, the gold leaf is laid on, and pressed down with cotton. This method of gilding is proper for work intended to be exposed to the weather.

The method of gilding in burnished gold consists in covering the work with parchment size and whiting, thinly laid on at five or six different times. This is covered with a yellow size made of Armenian bole, a little wax, and some parchment size; but in this, as in most other compositions used in the arts, there are variations which depend on the skill or the caprice of the artists. When the size is dry, the gold is applied upon the surface previously wetted with clear water. A certain number of hours after this application, but previous to perfect hardening of the composition, the gold may be very highly burnished with a tool of agate made for this purpose. This gilding is fit only for work within doors; for it readily comes off upon being wetted.

The edges of the leaves of books are gilded by applying a composition of one part Armenian bole, and one quarter of a part of sugar-candy, ground together with white of eggs. This is burnished while the book remains in the press, and the gold is laid on by means of a little water.

Leather is gilded either with leaf brass or silver, but most commonly by the latter, in which case a gold-coloured varnish is laid over the metal. Tin-foil may be used instead of silver-leaf for this less perfect gilding, upon such works as do not possess flexibility.

GIMBALS, in sea affairs, the brass rings by which a sea compass is suspended in its box, so as to counteract the effect of the ship's motion, and keep the card horizontal.

GIMBLETING, a term applied to the anchor to denote the action of turning it round by the stock, so that the motion of the stock appears similar to that of the handle of a gimblet when it is employed.

GIN. See GENEVA.

GIN, in mechanics, a machine for driving piles, fitted with a windlass and winches at each end, where eight or nine men heave, and round which a rope is reeved, that goes over the wheel at the top.

GINANNIA, a genus of the class and order enneandria monogynia. The calyx is double, both one-leaved, petals three-fringed and spreading; germ pedicelled, with a membranaceous wing at top. Legume. There is one species, a shrub of Guiana.

GINKGO, or maiden hair-tree, of the dioecia class (order and character unknown,) a large tree of Japan, with leaves resembling the adiantum, whence its popular name.

GINORA, a genus of the dodecandria monogynia class and order. The calyx is six-cletted; petals six; capsules one-seeded, four-celled, four-valved, coloured, many seeds. There is one species, an elegant shrub of Cuba, bearing handsome large red flowers.

GINGER. See AMOMUM.

GINSENG. See PANAX.

GIRDERS, in architecture, some of the largest pieces of timber in a floor. By the building act, no girder is to lie less than 10 inches into the wall, and the ends to be laid in loam.

GIRT, in the measuring of timber, is the circumference of a tree, though some use this word for the fourth part of the circumference only, on account of the use made of it. The square of the fourth part is considered as equal to the area of the section of the tree, which square therefore multiplied by the length of the tree is accounted the solid content.

GLACIERS is a name given to those extensive fields of ice and hardened snow, which occur in elevated mountainous districts, but especially in the Alps of Switzerland and Savoy.

The most remarkable phenomenon attending the glaciers is their near approach to the usual vegetation of summer, being separated only by the intervention of a few feet from the chilling influence of an endless bed of ice, which seems impenetrable to the rays of the sun. The depth of these astonishing accumulations of frozen fluid varies from 80 to 600 feet.

GLACIS, in fortification, that mass of earth which serves as a parapet to the covered way, sloping easily towards the champaign, or field. The glacis, otherwise called esplanade, is about six feet high, and loses itself by an insensible diminution in the space of ten fathoms.

GLADIATORS, in antiquity, persons who fought generally in the arena at Rome, for the entertainment of the people.

The gladiators were usually slaves, and fought out of necessity, though sometimes freemen made profession of it, like our prize-fighters for a livelihood. The Romans borrowed this cruel diversion from the Asiatics. They were all first sworn that they would fight till death; and if they failed they were put to death either by fire, swords, clubs, whips, &c. It was usual with the people or emperor to grant them life when they shewed no signs of fear. Augustus decreed that it should always be granted them. Constantine the Great had the humanity and courage to abolish the custom, after it had prevailed near six hundred years; but it revived under Constantius Theodosius and Valentinian, and was finally suppressed by the Emperor Honorius.

GLAREOLA, the *pratincole*, in natural history, a genus of birds of the order Grallæ. Generic character: bill strong, strait, short, hooked at the end; nostrils at the base, linear and oblique; feet four-toed; toes long, slender, connected at the base by a membrane; tail forked, consisting of twelve feathers. There are three species, of which the principal is P. austriaca; this is about as large as a blackbird, lives on water insects and on worms; is found in great numbers on the banks of the Rhine.

GLASS is an artificial substance, formed by the fusion of siliceous earth with various salts and metallic oxides, and possessing a high degree of transparency. It is one of the most useful and ornamental substances which the arts have yet produced. Various speculations have been offered to the world on the origin of this substance, which seem totally unworthy of notice: the most probable fact connected with the subject is that recorded by Pliny, which is as follows:

Some merchants with soda as part of their freight, had cast anchor at the mouth of the river Belus, in Phœnicia, and were dressing their dinner on the sand, making use of large lumps of the soda as supports for their kettles. The heat of the fire melted the soda, and the siliceous earth together; the result was glass. The hint was not lost, and a manufacture in that trading country was instantly established, and to this place it was for a long time confined. Glass was undoubtedly made in great perfection among the ancients. In their accounts we read of drinking glasses, glass prisms, and coloured glasses of various kinds. Glass was first used for windows in the third century of the Christian æra, but it did not come into common use till very long after this. There are five distinct kinds of glass at present manufactured:—

1. Flint glass, or glass of lead.
2. Plate glass, or glass of pure soda.
3. Crown glass, the best window-glass.
4. Broad glass, a coarse window glass.
5. Bottle, or coarse green glass.

1. *Flint glass*, so named because the siliceous ingredient was originally employed in the form of ground flints. It is now made of the following composition:—

Purified Lynn sand.	100 parts
Litharge or red lead,	60
Purified pearl ash,	30

To correct the green colour derived from combustible matter, or oxide of iron, a little black oxide of manganese is added, and sometimes nitre and arsenic. The fusion is accomplished usually in about thirty hours.

2. *Plate Glass.* Good carbonate of soda, procured by decomposing common salt with pearl ash, is employed as the flux. The proportion of the materials is,

Pure sand,	43.0
Dry subcarbonate of soda,	26.5
Pure quicklime,	4.
Nitre,	1.5
Broken plate glass,	25.0
	100.0

About seventy parts of good plate glass may be run off from these materials.

3. *Crown or fine window-glass.* This is made of sand vitrified by the impure barilla, manufactured by incineration of sea weed, on the Scotch and Irish shores. The most approved composition is,

	By measure.	By weight.
Fine sand purified,	5	— 200
Best kelp ground,	11	— 330

These ingredients are mixed, and then thrown into the fritting arch, where the sulphur of the kelp is dissipated, and the matters are thoroughly incorporated, forming, when withdrawn at the end of four hours, a greyish-white tough mass, which is cut into brick-shaped pieces, and after concretion and cooling, piled up for use. By long keeping, a soda efflorescence forms on their surface. They are then supposed to have become more valuable. These bricks are put into the melting pots, and sometimes a proportion of common salt is thrown in towards the end of the operation, if the vitrification has been imperfect. Gehlen, some time before his death, was occupied with experiments on the preparation of glass, by means of sulphate of soda. Prof. Schweigger has lately published the result of his trials. He found that the following proportions were the best:—

Sand; - - -	100
Dry sulphate of soda, -	50
Dry quicklime in powder, -	17 to 20
Charcoal, - - -	4

This mixture always gives a very good glass without any addition whatever. During the fusion, the sulphuric acid is decomposed and drawn off, and the soda unites with the silica. The sulphate of soda vitrifies very imperfectly, when mixed alone with the silica. The vitrification succeeds better when quicklime is added; and it succeeds completely, when the proportion of charcoal in the formula is added; because the sulphuric acid is thereby decomposed and dissipated. This decomposition may be either effected during the making of the glass, or before, at the pleasure of the workmen.

4. *Broad Glass.* This is made of a mixture of soap-boilers' waste, kelp, and sand. The first ingredient consists of lime used for rendering the alkali of the soap-boiler caustic, the insoluble matter of the kelp or barilla, and a quantity of salt and water, all in a pasty state. The proportions necessarily vary; 2 of the waste, 1 of kelp, and 1 of sand, form a pretty good broad glass. They are mixed together, dried, and fritted.

5. *Bottle Glass* is the coarsest kind. It is made of soaper's waste and river sand, in proportions which practice must determine according to the quantity of the waste; some soap-boilers extracting more saline matter, and others less from their kelps. Common sand and lime, with a little common clay and sea salt, form a cheap mixture for bottle glass.

As far as observation has hitherto directed us, it appears to be a general rule, that the hardness, brittleness, elasticity, and other mechanical properties of congealed bodies, are greatly affected by the degree of rapidity with which they assume the solid state.. This, which no doubt is referrible to the property of crystallization, and its various modes, is remarkably seen in steel and other metals, and seems to obtain in glass. When a drop of glass is suffered to fall into water, it is found to possess the remarkable property of flying into minute pieces, the instant a small part of the tail is broken off. This, which is commonly distinguished by the name of Prince Rupert's drop, is similar to the philosophical phial, which is a small vessel of thick glass suddenly cooled by exposure to the air. Such a vessel possesses the property of flying in pieces, when the smallest piece of flint or angular pebble is let fall into it, though a leaden bullet may be dropped into it from some height without injury. Many explanations have been offered, to account for these and other similar appearances, by referring to a supposed mechanism or arrangement of the particles, or sudden confinement of the matter of heat. The immediate cause, however, appears to be derived from the fact, that the dimensions of bodies suddenly cooled remain larger than if the refrigeration had been more gradual. Thus the specific gravity of steel hardened by sudden cooling in water is less, and its dimensions consequently greater than that of the same steel gradually cooled. It is more than probable, that an effect of the same nature obtains in glass; so that the dimensions of the external and suddenly cooled surface remain longer than are suited to the accurate envelopement of the interior part, which is less slowly cooled. In most of the metals, the degree of flexibility they possess, must be sufficient to remedy this inaccuracy as it takes place, but in glass, which, though very elastic and flexible, is likewise excessively brittle, the adaptation of the parts, urged different ways by their disposition to retain their respective dimensions, and likewise to remain in contact by virtue of the cohesive attraction, can be maintained only by an elastic yielding of the whole, as far as may be, which will therefore remain in a state of tension. It is not therefore to be wondered at, that a solution of continuity of any part of the surface should destroy this equilibrium of elasticity; and that the sudden action of all the parts at once, of so brittle a material, should destroy the continuity of the whole, instead of producing an equilibrium of any other kind.

Though the facts relating to this disposition of glass too suddenly cooled, are numerous and interesting to the philosopher, yet they constitute a serious evil with respect to the uses of this excellent material. The remedy of the glass-maker consists in annealing the several articles, which is done by placing them in a furnace near the furnace of fusion. The glasses are first put into the hottest part of this furnace, and gradually removed to the cooler parts at regular intervals of time. By this means the glass cools very slowly throughout, and is in a great measure free from the defects of glass which has been too hastily cooled.

The different coloured glasses owe their tints to the different metallic oxides, mixed with the glass, or materials, while in a state of fusion. *Blue* glass is formed by the oxide of cobalt; *green* by the oxide of iron or copper *violet* by the oxide of manganese; *red* by mixture of the oxides of copper and iron *purple* by the oxide of gold; *white* by the oxid of arsenic and zinc; *yellow* by the oxide of silver and by combustible bodies, and *black* from a mixture of oxide of manganese, cobalt, and iron. In this manner are made those

elegant pastes, which so faithfully imitate, and not unfrequently excel, in brilliance, their originals, the gems of antiquity. The *glass*, however, for this purpose, is prepared in a peculiar manner, and requires great nicety. It combines purity and durability. *Opaque* glass is made by the addition of the oxide of tin, and produces that beautiful imitation of *enamel* which is so much admired. Dials for watches and clocks are made in this manner.

The following is a brief account of the common process of glass blowing, and of the principal instruments used by the workmen.—The workman has a tube of iron, the end of which he dips into a pot of melted glass, and thus gathers a small quantity of glass on the end of it, he then applies the other end of the tube to his mouth and blows air through it, this enters into the body of the fluid glass, and expands it out, into a hollow globe, similar to the soap bladders blown from a tobacco-pipe. Various methods are used to bring these hollow globes into forms of the different utensils in common domestic use, and several tools.

The furnace consists of two large domes one over the other, the lower one stands over a long grating, (on a level with the ground,) on which the fuel is placed; beneath the grate is the ash pit, and a large arch leading to it, conveys air to the furnace. In the sides of the lower dome, as many holes or mouths are made as there are workmen to make use of the furnace, and before each mouth a pot of melted glass is placed; the pots are very large like crucibles, and will hold from three to four hundred weight of liquid glass, they are supported upon three small piers of brickwork, resting on the floor of the furnace. The form reverberates the flame from the roof down upon the pots, and they are placed at some distance within the furnace, that the flame may get between the wall and the pots. The upper dome is built upon the other, and its floor made flat by filling up round the roof of the lower dome with brickwork, there is a small chimney opens from the top of the lower dome into the middle of the floor of the upper one, which conveys the smoke away from it, and a flue from the upper dome leads it completely from the furnace. The upper dome is used for annealing the glass, and is exactly similar to a large oven, it has three mouths, and in different parts a small flight of steps leads up to each.

The principal implements used by the glass-blower are, a blowing-pipe, which is an iron pipe about two feet long, with rope-yarn wrapped round where the workman takes hold of it; two or three iron rods of the same length; a pair of blunt shears, and several different sized ladles, shovels, pokers, &c. and two stools.

For explaining the operation, we shall describe the method of making a goblet. The workman dips the end of his blowing-pipe, which is hot, through the hole into the melting pot, and by turning it about, a small quantity of the glass, which is called metal, sticks to the iron: this he repeats three or four times (between each dip rolling it on an iron plate, fixed on a stool, till he has got metal enough:) he then blows through the pipe, which expands the metal into a hollow globular form; and then by swinging it round his head, it lengthens out in the shape of a bladder The workman then sits down on a stool, between the two bars, across which he lays the blowing-iron, and rolls it along under his left hand, following it at the same time with the shears, in his right hand, the blades of which embrace it, and by gently putting them in the proper place, he brings the glass into the required form; meanwhile, the boy who attends him brings a lump of metal from the furnace on the end of one of the iron rods which he sticks on the bottom, and by twisting the rod round, he separates the metal from the rod, and leaves it on the glass vessel; the workman then rolls the rod and vessel as before, and with his shears brings the lump of glass into the form of a stem and foot. The boy then holds the tool against the bottom of the foot, while it is turning to flatten it; the boy next takes another iron rod, and gets a very small piece of metal on its end, this he applies to the centre of the bottom of the foot; so as to connect it to the rod; when the workman, by touching it at the neck with a wet iron, cracks the glass, so that a slight blow upon the rod with the hand will separate it from the blowing-pipe. The glass has by this time become too cold to work without heating again, which is done before the fire; the workman then returns to the stool, and again rolls the rod round with his left hand as before, and with the point of one of the blades of the shears opens the end of the glass; after which he inserts both points, and finally works it into the form of a goblet. It is now separated from the rod, and is carried on a shovel like a baker's peel by the boy to the annealing furnace, or oven, in the upper part of the furnace, where it remains in a low red heat for many hours, by which its former extreme brittleness is removed.

Window-glass is made in a similar manner, except that the liquid mass at the end of the tube is formed into a cylindrical shape, which being cut longitudinally by scissars or shears, is gradually bent back until it becomes a flat plate.

GLAUBER'S-*salt*, a cathartic or purging salt. See SODA, *sulphat of*.

GLAUCOPIS, in ornithology, a genus of birds of the order picæ. Bill incurvate, arched, the lower mandible shorter, and carunculate beneath at the base; nostrils depressed, half-covered with a membrane; tongue slit, and fringed at the tip; feet walkers. It inhabits New Zealand.

GLAZING, the crusting over earthen ware by a vitreous substance, the base of which is commonly lead. See POTTERY.

GLEANING, in law. It has been said, that by the common law and custom of England, the poor are allowed to enter and glean upon another's ground, after the harvest, without being guilty of trespass; and that this humane provision seems borrowed from the Mosaical law; but it is now positively settled, by a solemn judgment of the court of Common Pleas, that a right to glean in the harvest field cannot be claimed as a general right by every person at common law; nor as a custom by the poor of a parish, legally settled.

GLEBE, or *Glebe-land*, is a portion of land, meadow or pasture, belonging to, or parcel of the parsonage or vicarage, over and above the tithes.

GLEE, in music, a vocal composition in three or more parts, generally consisting of

more than one movement, the subject of which may be either gay, tender, or grave; bachanalian, amatory, or pathetic.

GLIRES, the name given by Linnæus to the fourth order of the mammalia; the character of which is, fore-teeth cutting, two in each jaw; no tusks; feet with claws formed for running and bounding; food, bark, roots, vegetables, &c. which they gnaw. The order includes ten genera, viz. the hystrix, cavia, castor, mus, arctomys, sciurus, myoxus, dipus, lepus, and hyrax.

GLOBE, in geometry signifies a round or spherical body, more commonly called a sphere. See SPHERE.

GLOBE, is more particularly used for an artificial sphere, on the surface of which is drawn a map or representation of the earth or of the heavens, with the several imaginary circles.

The globes commonly used are composed of plaster and paper in the following manner: A wooden axis is provided, somewhat less than the intended diameter of the globe, and into the extremes two iron wires are driven for poles: this axis is to be the beam or basis of the whole structure. On the axis are applied two spherical or rather hemispherical caps, formed on a kind of wooden mould or block. These caps consist of pasteboard or paper, laid one lay after another on the mould, to the thickness of a crown-piece; after which, having stood to dry and embody, making an incision along the middle, the two caps thus parted are slipped off the mould. They remain now to be applied on the poles of the axis, as before they were on those of the mould; and to fix them in their new place, the two edges are sewed together with packthread, &c. The rudiments of the globe thus laid, they proceed to strengthen and make it smooth and regular. In order to this, the two poles are hasped in a metalline semicircle of the size intended; and a kind of plaster made of whiting, water, and glue, heated, melted, and incorporated together, is daubed all over the paper surface. In proportion as the plaster is applied, the ball is turned round in the semicircle, the edge of which pares off whatever is superfluous, and beyond the due dimension, leaving the rest adhering in places that are short of it. After such application of plaster, the ball stands to dry; when dry it is put again in the semicircle, and fresh matter applied: thus they continue alternately to apply the composition, and dry it, till the ball every where accurately touches the semicircle; in which state it is perfectly smooth, regular, and complete. The ball thus finished, it remains to paste the map on it. In order to this, the map is projected in several gores, all which join accurately on the spherical surface, and cover the whole ball. To direct the application of these gores, lines are drawn by a semicircle on the surface of the ball, dividing it into a number of equal parts corresponding to those of the gores, and subdividing those again answerably to the lines and divisions of the gores.

The papers thus pasted on, there remains nothing but to colour and illuminate the globe, and to varnish it, the better to resist dust, moisture, &c. The globe itself thus finished, they hang it in a brass meridian, with an hour-circle and a quadrant of altitude, and thus fit it into a wooden horizon.

There are ten principal circles represented upon globes, viz. six greater and four lesser ones. The greater circles are the horizon, meridian, and equinoctial, as it is called on the celestial, and equator on the terrestrial globe, the ecliptic drawn along the middle of the zodiac, and the two colures. The lesser circles, of principal use, are the two tropics and two polar circles. Of these circles some are fixed, and always obtain the same position; others moveable, according to the position of the observer. The fixed circles are the equator and ecliptic, with their parallels and secondaries; which are usually delineated upon the surface of the globes. The moveable circles are the horizon, with its parallels and secondaries.

The horizon is a broad wooden circle surrounding the globe, and dividing it into two equal parts, called the upper and lower hemispheres. It has two notches, to let the brazen meridian slip up and down, according to the different heights of the pole. On the flat side of this circle are described the twelve signs, the months of the year, the points of the compass, &c. The brazen meridian is a ring of brass, divided into degrees. It divides the globe into two equal parts, called the eastern and western hemispheres. The quadrant of altitude is a thin pliable plate of brass, answering exactly to a quadrant of the meridian. It is divided into 90°, and has a notch, nut and screw, to fix to the brazen meridian in the zenith of any place, where it turns round a pivot, and supplies the room of vertical circles. The hour-circle is a flat ring of brass, divided into 24 equal parts or hour distances; and on the pole of the globe is fixed an index that turns round with the globe, and points out the hours upon the hour-circle. Lastly, there are generally added a compass and needle upon the pediment of the frame.

The surface of the celestial globe may be esteemed a just representation of the concave expanse of the heavens, notwithstanding its convexity; for it is easy to conceive the eye placed in the centre of the globe, and viewing the stars on its surface. The stars are all disposed in constellations under the forms of various animals, whose names and figures are represented on the celestial globe, which were first invented by the ancient astronomers and poets, and are still retained for the better distinction of these luminaries.

Various improvements have been made in the construction of globes, some of which are of great importance in working the problems; among the latest of these may be mentioned the terrestrial globe of Mr. Christie, which is so mounted as to exhibit the diurnal and annual revolutions of the earth. This globe, while it is made to revolve on its own axis, is moved, by the aid of two parallel levers, round a hollow sphere of ground glass, within which a lamp is placed, and from which a strong light is thrown upon the globe.

As, however, globes mounted either in this way, or on other improved principles, are in the possession of comparatively few persons, the following problems are selected for the use of those who have globes mounted in the common way.

PROBLEMS ON THE TERRESTRIAL GLOBE.

1. *To find the latitude of any place.* Bring the given place to the brazen meridian, and

observe what degree it is under, for that is the latitude required.

2. *To rectify the globe for any given place.* Raise the pole so many degrees above the horizon as are equal to the latitude of the place; then, finding the sun's place, bring it to the meridian; screw the quadrant of altitude on the zenith; set the index of the hour-circle to the upper XII, and place the globe due north and south by the compass.

3. *To find the longitude of a given place.* Bring the place to the brazen meridian, and observe the degree of the equator under the same, for that expresses the longitude required.

4. *To find any place by the latitude and longitude given.* Bring the given degree of longitude to the meridian, and under the given degree of latitude you will see the place required.

5. *To find all those places which have the same latitude or longitude with those of any given place.* Bring the given place to the meridian; then all those places which lie under the meridian have the same longitude: again, turn the globe round on its axis; then all those places which pass under the same degree of the meridian with any given place have the same latitude with it.

6. *To find all those places where it is noon at any given hour of the day in any place.* Bring the given place to the meridian, set the index to the given hour; then turn the globe till the said index points to the upper XII, and observe what places lie under the brass meridian; for to them it is noon at that time.

7. *When it is noon at any one place, to find what hour it is at any other given place.* Bring the first given place to the meridian, and set the index to the upper XII; then turn the globe till the other given place comes to the meridian, and the index will point to the hour required.

8. *For any given hour of the day in the place where you are, to find the hour of the day in any other place.* Bring the place where you are to the meridian, set the index to the given hour, then turn the globe about; and when the other place comes to the meridian, the index will shew the hour of the day there as required.

9. *To find the distance between any two places in English miles.* Bring one place to the meridian, over which fix the quadrant of altitude; and then laying it over the other place, count the number of degrees thereon contained between them; which number multiply by 69½ (the number of miles in one degree,) and the product is the number of English miles required.

10. *To find how any one place bears from another.* Bring one place to the brass meridian, and lay the quadrant of altitude over the other, and it will shew on the horizon the point of the compass on which the latter bears from the former.

11. *To find those places to which the sun is vertical in the torrid zone for any given day.* Find the sun's place in the ecliptic for the given time, and bring it to the meridian, and observe what degree thereof it cuts; then turn the globe about, and all those places which pass under that degree of the meridian, are those required.

12. *To find what day of the year the sun will be vertical in any given place in the torrid zone.* Bring the given place to the meridian, and mark the degree exactly over it; then turn the globe round, and observe the two points of the ecliptic which pass under that degree of the meridian: lastly, see on the wooden horizon on what days of the year the sun is in those points of the ecliptic; for those are the days required.

13. *To find those places in the north frigid zone where the sun begins to shine constantly without setting, on any given day between the 21st of March and the 21st of June.* Find the sun's place in the ecliptic for the given day, bring it to the brazen meridian, and observe the degrees of declination; then all those places which are the same number of degrees distant from the pole are the places required to be found.

14. *To find on what day the sun begins to shine constantly without setting, on any given place in the north frigid zone, and how long.* Rectify the globe to the latitude of the place, and, turning it about, observe what point of the ecliptic between Aries and Cancer, and also between Cancer and Libra, coincides with the north point of the horizon; then find, by the calendar on the horizon, what days the sun will enter those degrees of the ecliptic, and they will solve the problem.

15. *To find the place to which the sun is vertical on any given day and hour.* Find the sun's place, and bring it to the meridian, and mark the degree of declination for the given hour; then find those places which have the sun in the meridian at that time; and among them that which passes under the degree of declination is the place required.

16. *To find, for any given day and hour, those places wherein the sun is then rising and setting, or on the meridian; also those places which are enlightened, and those which are not.* Find the place to which the sun is vertical at the given time, and bring the same to the meridian, and elevate the pole to the latitude of the place. then all those places which are in the western semicircle of the horizon have the sun rising, and those in the eastern semicircle see it setting; and to those under the meridian it is noon. Lastly, all places above the horizon are enlightened, and all below it are in darkness.

17. *The day and hour of a solar or lunar eclipse being given, to find all those places in which the same will be visible.* Find the place to which the sun is vertical at the given instant, and elevate the globe to the latitude of the place; then in most of those places above the horizon will the sun be visible during his eclipse; and all those places below the horizon will see the moon pass through the shadow of the earth in her eclipse.

18. *The length of a degree being given, to find the number of miles in a great circle of the earth, and thence the diameter of the earth.* Admit that one degree contains 69½ English statute miles; then multiply 360 (the number of degrees in a great circle) by 69½, and the product will be 25020, the miles which measure the circumference of the earth. If this number be divided by 3.1416, the quotient will be 7963 $\frac{86}{100}$ miles for the diameter of the earth.

19. *The diameter of the earth being known, to find the surface in square miles, and its solidity in cubic miles.* Admit the diameter to be 7964 miles; then multiply the square of the diameter by 3.1416, and the product will be 199250205 very nearly, which are the

square miles in the surface of the earth. Again, multiply the cube of the diameter by 0.5236, and the product 264466789170 will be the number of the cubic miles in the whole globe of the earth.

20. *To express the velocity of the diurnal motion of the earth.* Since a place in the equator describes a circle of 25020 miles in 24 hours, it is evident, that the velocity with which it moves is at the rate of 1042½ in one hour, or 17$\frac{3}{10}$ miles per minute. The velocity in any parallel of latitude decreases in the proportion of the co-sine of the latitude to the radius.

Thus, for the latitude of London, 51° 30′, say,

As radius.......................................10.000000
To the co-sine of lat. 51° 30′....... 9.794149
So is the velocity in the equator, 17$\frac{3}{10}$′.......................................} 2.238046
To the velocity of the city of London, 10$\frac{8}{10}$′.................................} 2.032195

That is, the city of London moves about the axis of the earth at the rate of 10$\frac{8}{10}$ miles every minute of time: but this is far short of the velocity of the annual motion about the sun; for that is at the rate of more than 65,000 miles per hour.

PROBLEMS ON THE CELESTIAL GLOBE.

1. *To rectify the globe.* Raise or elevate the pole to the latitude of the place; screw the quadrant of altitude in the zenith; set the index of the hour-circle to the upper XII, and place the globe north and south by the compass and needle: then it is a just representation of the heavens for the given day at noon.

2. *To find the sun's place in the ecliptic.* Find the day of the month in the calendar on the horizon, and against it is the degree of the ecliptic which the sun is in for that day.

3. *To find the sun's declination.* Rectify the globe, bring the sun's place in the ecliptic to the meridian, and that degree which it cuts in the meridian is the declination required.

4. *To find the sun's right ascension.* Bring the sun's place to the meridian, and the degree of the equinoctial cut by the meridian is the right ascension required.

5. *To find the sun's amplitude.* Bring the sun's place to the horizon, and the arch of the horizon intercepted between it and the east or west point, is the amplitude, north or south.

6. *To find the sun's amplitude for any given day and hour.* Bring the sun's place to the meridian, set the hour-index to the upper XII; then turn the globe till the index points to the given hour; then screwing the quadrant of altitude in the zenith, lay it over the sun's place, and the arch contained between it and the horizon will give the degrees of altitude required.

7. *To find the sun's azimuth for any hour of the day.* Every thing being done as in the last problem, the arch of the horizon contained between the north point and that where the quadrant of altitude cuts it, is the azimuth east or west as required.

8. *To find the time when the sun rises or sets.* Find the sun's place for the given day, bring it to the meridian, and set the index to XII; then turn the globe till the sun's place touches the east part of the horizon, the index will shew the hour of its rising; turn the globe to the west part of the horizon, and the index will shew the time of its setting for the given day.

9. *To find the length of any given day or night.* This is known by taking the number of hours between the rising and setting of the sun for the length of the day; and the remainder to 24, for the length of the night.

10. *To find the hour of the day, having the sun's altitude given.* Bring the sun's place to the meridian, and set the index to XII; then turn the globe in such a manner, that the sun's place may move along by the quadrant of altitude (fixed in the zenith) till it touches the degree of the given altitude, and the index will shew the hour required.

11. *To find the place of the moon, or any planet, for any given day.* Take White's Ephemeris, and against the given day of the month you will find the degree and minute of the sign which the moon or planet possesses at noon. The degree thus found being marked in the ecliptic on the globe by a small notch or otherwise, you may then proceed to find the declination, right ascension, latitude, longitude, altitude, azimuth, rising, southing, setting, &c. in the same manner as has been shewn for the sun.

12. *To explain the phænomena of the harvest moon.* In order to this we need only consider, that when the sun is in the beginning of Aries, the full moon on that day must be in the beginning of Libra: and since, when the sun sets, or the moon rises on that day, those equinoctial points will be in the horizon, and the ecliptic will then be least of all inclined thereto, the part or arch which the moon describes in one day, viz. 13°, will take up about an hour and a quarter ascending above the horizon; and, therefore, so long will be the time after sun-set, the next night, before the moon will rise. But at the opposite time of the year, when the sun is in the autumnal, and the full-moon in the vernal, equinox, the ecliptic will, when the sun is setting, have the greatest inclination to the horizon; and, therefore 13° will in this case soon ascend, viz. in about a quarter of an hour; and so long after sun-set will the moon rise the next day after the full: whence, at this time of the year, there is much more moonlight than in the spring; and hence this autumnal full moon came to be called the harvest moon, the hunter's or shepherd's moon; all which may be clearly shewn on the globe.

13. *To represent the face of the starry firmament, for any given hour of the night.* Rectify the globe, and turn it about till the index points to the given hour; then will all the upper hemisphere of the globe represent the visible half of the heavens, and all the stars on the globe will be in such situations as exactly correspond to those in the heavens, which may therefore be easily found, as will be shewn in the 16th problem.

14. *To find the hour when any known star will rise, or come upon the meridian.* Rectify the globe and set the index to XII; then turn

the globe till the star comes to the horizon or meridian, and the index will shew the hour required.

15. *To find at what time of the year any given star will be on the meridian at* XII *at night.* Bring the star to the meridian, and observe what degree of the ecliptic is on the north meridian under the horizon; then find in the calendar on the horizon the day of the year against that degree, and it will be the day required.

16. *To find any particular star.* First, find its altitude in the heavens by a quadrant, and the point of the compass it bears on: then, the globe being rectified, and the index turned to he given hour, if the quadrant of altitude is ixed on the zenith, and laid towards the point of the compass on which the star was observed, the star required will be found at the same degree of altitude on the quadrant, as it was by observation in the heavens.

GLOBULAR CHART, a name given to the representation of the surface, or of some part of the surface of the terrestrial globe upon a plane, wherein the parallels of latitude are circles nearly concentric, the meridian curves bending towards the poles, and the romb-lines are also curves.

GLOBULAR SAILING. See SAILING.

GLOBULARIA, *globular blue daisy*, a genus of the monogynia order, in the tetrandria class of plants, and in the natural method ranking under the 48th order, aggregatæ. There are eight species, but one only is commonly to be met with in our gardens, viz. the vulgaris, or common blue daisy.

GLOW-WORM. See CICINDELA.

GLUCINA, in chemistry, an earth lately discovered by Vauquelin, while he was analyzing the beryl, to ascertain whether its constituent parts were the same as those of the emerald. In this experiment he found the glucina, which he so named from its sweetish taste. Glucina, in the form of powder, or in fragments, is almost three times as heavy as water; it is infusible in the fire; it does not contract, like alumina, by great heat, and it has no effect on vegetable colours. It combines with sulphurated hydrogen. It is insoluble in water, but combines with acids, making with them soluble salts, distinguished by a sweet and slightly astringent taste.

GLUE. An inspissated jelly made from the parings of hides and other offals, by boiling them in water, straining through a wicker basket, suffering the impurities to subside, and then boiling it a second time. The articles should first be digested in lime water, to cleanse them from grease and dirt; then steeped in water, stirring them well from time to time; and lastly laid in a heap, to have the water pressed out, before they are put into the boiler. Some recommend that the water should be kept as nearly as possible to a boiling heat, without suffering it to enter into ebullition. In this state it is poured into flat frames or moulds, then cut into square pieces when congealed, and afterwards dried in a coarse net. It is said to improve by age; and that glue is reckoned the best, which swells considerably without dissolving by three or four days' infusion in cold water, and recovers its former dimensions and properties by drying.

Shreds or parings of vellum, parchment, or white leather, make a clear and almost colourless glue.

GLUTEN. If wheat flour be made into a paste, and washed in a large quantity of water, it is separated into three distinct substances: a mucilaginous saccharine matter, which is readily dissolved in the liquor, and may be separated from it by evaporation; starch, which is suspended in the fluid, and subsides to the bottom by repose; and gluten, which remains in the hand, and is tenacious, very ductile, somewhat elastic, and of a brown-grey colour. The first of these substances does not essentially differ from other saccharine mucilages. The second, namely the starch, forms a gluey fluid by boiling in water, though it is scarcely, if at all, acted upon by that fluid when cold. Its habitudes and products with the fire, or with nitric acid, are nearly the same as those of gum and of sugar. It appears to be as much more remote from the saline state than gum, as gum is more remote from that state than sugar.

The vegetable gluten, though it existed before the washing in the pulverulent form, and has acquired its tenacity and adhesive qualities from the water it has imbibed, is nevertheless totally insoluble in this fluid. It has scarcely any taste. When dry, it is semitransparent, and resembles glue in its colour and appearance. If it be drawn out thin, when first obtained, it may be dried by exposure to the air; but if it be exposed to warmth and moisture while wet, it putrefies like an animal substance. The dried gluten applied to the flame of a candle, crackles, swells, and burns, exactly like a feather, or piece of horn. It affords the same products by destructive distillation as animal matters do; is not soluble in alcohol, oils, or ether; and is acted upon by acids, and alkalis, when heated. According to Rouelle, it is the same with the caseous substance of milk.

GLYCYRRHIZA, or *liquorice*, a genus of the diadelphia decandria class and order. Natural order of papilionaceæ or leguminosæ. There are four species. These are tall growing perennial, herbaceous plants, with the stalks somewhat woody at bottom. Stipules are distinct from the petiole; flowers in a head or spike from the axils and at the ends of the branches; seed vessel a legume or pod, smooth, hairy, or prickly. Their propagation is effected by cuttings of the small roots. An open situation and a deep loose soil is the most suitable for them. In three years the roots will be fit to take up. Liquorice is almost the only sweet that quenches thirst, and has been employed in hydropic cases, to prevent the necessity of drinking. An extract is made from the root.

GLYPH, in sculpture and architecture, denotes any canal or cavity, used as an ornament.

GMELINA, in botany, so called in honour of Joh. George Gmelin, professor of natural history at St. Petersburgh, afterwards of Botany at Tubingen, a genus of the angiospermia order, in the didynamia class of plants, and in the natural method ranking under the 40th order, personatæ. The calyx is nearly quadridentated; the corolla campanulated or bell-shaped; there are two bipartite and two simple antheræ; the fruit is a plum with a bilocular kernel. There is one species, a tree of Malabar.

GNEISS. A compound rock, consisting of felspar, quartz, and mica, disposed in slates, from the predominance of the mica scales. Its structure is called by Werner, granular-slaty. This geognostic formation is always stratified; contains sometimes crystals of schorl, tourmaline, and garnet, and is peculiarly rich in metallic ores.

GNOMON, in dialling, the style, pin, or cock of a dial, which by its shadow shews the hour of the day. The gnomon of every dial represents the axis of the world. See DIAL and DIALLING.

GNOSTICS, in church history, Christians so called, it being a name which almost all the ancient heretics affected to take to express that new knowledge and extraordinary light to which they made pretensions; the word gnostic signifying a learned or enlightened person.

GOAT. See CAPRA.

GOAT *sucker.* See CAPRIMULGUS. These birds are regarded by the American Indians as very ominous. They believe that goat-suckers were not known in their country till the English had made depredation upon it, and that they are, in fact, the departed spirits of the murdered Indians. In Carolina the lower class of people look upon them as birds of ill omen, and are gloomy and almost melancholy if one alights on the house or near the door, and begins its call, which they will sometimes do, even on the very threshold, imagining that it is a sure prognostic of the death of one of the family.

GOBIUS, the *goby,* in natural history, a genus of fishes of the order Thoracici. Generic character; head small; eyes approximated, with two punctures between them; gill membrane, four-rayed; ventral fins, united into a funnel-like oval; dorsal fins two. There are twenty-five species.

GOD, *Deus,* the Supreme Being, the first cause or creator of the universe, and consequently, the only proper object of religious worship. There cannot possibly be any subject respecting which it is of such importance for human beings to form correct notions as this. Many truly able, and pious arguments have been produced in favour of the existence of God, but it cannot be denied that while those arguments produce their full effect on the mind as to the fact itself, they, in general, leave it in a state of great perplexity, amounting almost to distraction, as to what *definite* idea should be entertained of the GREAT SUPREME. It is true that a question of such moment ought to be approached by finite creatures with the most profound reverence; yet if it is true that the grand object of Divine Revelation is to communicate to man the true knowledge of his Maker, it cannot be deemed presumption to infer that, in that divinely inspired volume, there is such a sufficiency of information afforded as shall form for the most anxious mind a suitable resting place.

The grand defect to which we here allude is the vague manner in which philosophers and theologians have treated the subject of the divine existence. This has arisen from the difficulty of elevating the mind to the contemplation of God as existing in a definite form, yet totally independent of the limits of time and space. That acute reasoner, Dr. Priestley, in his Essays on Matter and Spirit, evidently evinces that he conceives of God as subject to extension, as having properties in common with matter, as bearing relation to space, and, in one word, as being himself absolutely *material,* and having nothing of immateriality about him. From this it is very obvious that the Doctor, if he allow the Divine Being to possess any form at all, must admit that that form is the form assumed by infinite space, which is acknowledging that the Deity exists in the form of an infinitely extended sphere, an idea unworthy of a moment's serious consideration.

Now, it is a striking fact, to which every man's experience will bear witness, that until the mind is sophisticated by reasonings on the subject, it never thinks of God as existing in any other than the human form. And whence arises this universal impression? Doubtless from these two very obvious, though but little attended to circumstances. 1. That throughout the innumerable and endlessly varied objects of the visible creation, there is, more nearly or remotely, a tendency to the human form; and we are well assured that man himself was originally created an image and likeness of his Maker. 2. That throughout the whole of divine revelation where any intimation is given of the appearance of the Deity, (and instances of this are numerous,) it was always in the human form. And let it be particularly remembered, that all those appearances had a direct bearing upon his final manifestation upon earth for the redemption and salvation of mankind, which no one will deny was also in the human form. And after this most wonderful event was accomplished, still he appeared in the proper form of man; in this form he was seen when encircled with all the glory of the celestial world; and the plainest intimations are given in Scripture, that throughout eternity he will never be beheld in any other.

GOLD. See CHEMISTRY.

GOLD *leaf.* The method of extending gold used by the gold-beaters, consists in hammering a number of thin rolled plates between skins or animal membranes. By the weight and measure of the best wrought gold leaf, it is found, that one grain is made to cover 56¾ square inches; and from the specific gravity of the metal, together with this admeasurement, it follows, that the leaf itself is $\frac{1}{282000}$ part of an inch thick. This, however, is not the limit of the malleability of gold; for the gold-beaters find it necessary to add three grains of copper in the ounce to harden the gold, which otherwise would pass round the irregularities of the newest skins, and not over them; and in using the old skins, which are not so perfect and smooth, they proceed so far as to add twelve grains.

GOLD *wire.* The wire which is used by the lace-makers, is drawn from an ingot of silver, previously gilded. In this way, from the known diameter of the wire, or breadth when flattened, and its length, together with the quantity of gold used, it is found, by computation, that the covering of gold is only one 12th part of the thickness of gold-leaf, though it still is so perfect as to exhibit no cracks when viewed by a microscope.

GOLD *potable.* Ether, naphtha, and essential oils, take gold from its solvent, and form liquors, which have been called potable gold

The gold which is precipitated by evaporation of these fluids, or by the addition of sulphate of iron to the solution of gold, is of the utmost purity.

Gold *fulminating*. See Chemistry.

Gold, *shell*, that used by the illuminers to write gold letters, is made with the parings of leaf-gold, and even of the leaves themselves, reduced into an impalpable powder, by grinding on a marble with honey. After leaving it to infuse some time in aquafortis, they put it in shells, where it sticks. To use it, they dilute it with gum-water, or soap-water.

GOLDFINCH. See Fringilla.

GOLDSMITH, or silversmith, an artist who makes vessels, utensils, and ornaments, in gold and silver.

The goldsmith's work is either performed in the mould, or beaten out with the hammer, or other engine. All works that have raised figures are cast in a mould, and afterwards polished and finished: plates or dishes of silver or gold are beaten out from thin flat plates; and tankards, and other vessels of that kind, are formed of plates soldered together, and their mouldings are beaten, not cast.

GOLDEN *number*, a number shewing what year of the moon's cycle any year is.

GONDOLA, in naval architecture, a flat kind of boat, very long and narrow, chiefly used on the canals at Venice.

GONG, in music, an instrument used in China, is made of a metal composed of silver, lead, and copper, and its shape is a sort of circular concave. The tone is loud, harsh, and clanging. It is never introduced except on occasion of giving a national cast to the music in which it is employed, or to awaken surprize, and rouse the attention of the company.

GONIOMETER. The instrument for measuring the angles of crystals is called a goniometer, of which there are two kinds. 1. The goniometer of M. Carangeau, used by M. Haüy, consists of two parallel blades, jointed like those of scissars, and capable of being applied to a graduated semicircular sector, which gives the angle to which the joint is opened, in consequence of the previous apposition of the two blades to the angle of the crystal. 2. The reflective goniometer of Dr. Wollaston; an admirable invention, which measures the angles of the minutest possible crystals with the utmost precision. To these we may add another invented by Dr. Brewster, and described in the Edinburgh Encyclopædia, Vol. 10. It is much the same as that of Dr. Wollaston, but differs in the application of the principle of construction, and is capable of measuring a hollow angle.

GONIUM, a genus of vermes, of the order infusoria. Worm very simple, flat, angular, invisible to the naked eye. There are five species. The pectoral, quadrangular, pellucid, with 16 spherical molecules, found in pure water; molecules oval, nearly equal in size, set in a quadrangular membrane, like diamonds in a ring, the lower ones a little larger than the rest.

GOOSE. See Anas.

Goose *berry*. See Ribes.

Goose *neck*, in a ship, a piece of iron fixed on the end of the tiller, to which the laniard of the whip-staff, or the wheel rope comes for steering the ship

Goose *wing*, in the sea-language. When a ship sails before, or with, a quarter-wind on a fresh gale, to make the more haste, they launch out a boom, and sail on the lee-side; and a sail so fitted, is called a goose-wing.

GORDIUS, in natural history, *hair-worm*, a genus of the vermes intestina class and order. Body round, filiform, equal, smooth. There are five species. G. aquaticus is from four to six inches long, of a pale brown colour, but darker at the extremities: it is found in stagnant waters, and twists itself into various contortions and knots, and it is said that if it is handled without caution, it will inflict a bite that occasions the whitlow.

GORGONIA, in natural history, a genus of the vermes zoophyta class and order. Animal growing in the form of a plant; stem coriaceous, corky, woody, horny, or bony, composed of glassy fibres, or like stone, striate, tapering, dilated at the base, covered with a vascular or cellular flesh or bark, and becoming spongy and friable when dry; mouths or florets covering the surface of the stem and polype bearing. There are about forty species.

GOSHAWK. See Falco.

GOSSAMER, is the name of a fine filmy substance, like cobweb, which is seen to float in the air in clear days in autumn, and is more observable in stubble-fields, and upon furze and other low bushes. This is probably formed by the flying spider, which, in traversing the air for food, shoots out these threads from its anus, which are borne down by the dew, &c.

GOSSYPIUM, or cotton; a genus of the polyandria order, in the monadelphia class of plants, and in the natural method ranking under the 37th order, columniferæ. The calyx is double, the exterior one trifid; the capsule quadrilocular; the seeds wrapt in cotton-wool. There are six species, all of them natives of warm climates. 1. The herbaceum, or common herbaceous cotton, has an herbaceous smooth stalk two feet high, branching upwards; five-lobed smooth leaves; and yellow flowers from the ends of the branches, succeeded by roundish capsules full of seed and cotton. 2. The hirsutum, or hairy American cotton, has hairy stalks branching laterally two or three feet high; palmated, three and five-lobed hairy leaves; and yellow flowers, succeeded by large oval pods furnished with seeds and cotton. 3. The barbadense, or Barbadoes shrubby cotton, has a shrubby stalk branching four or five feet high, three lobed smooth leaves, glandulous underneath: and yellow flowers succeeded by oval pods, containing seeds and cotton. 4. The arboreum, or tree cotton, has an upright woody perennial stalk, branching six or eight feet high; palmated, four or five-lobed smooth leaves, and yellow flowers, succeeded by large pods filled with seeds and cotton. The first three species are annual, but the fourth is perennial both in root and stalk. In warm countries these plants are cultivated in great quantities in the fields for the sake of the cotton they produce; but the first species is most generally cultivated. The pods are sometimes as large as middling-sized apples, closely filled with the cotton surrounding the seed.

GOTHIC *style*, in architecture. The characteristics of this manner of building are pointed arches, greater height than breadth in the proportions, and profuse ornament chiefly derived

from an imitation of the leaves and flowers of plants.

GOVERNMENT, in general, is the polity of a state, or an orderly power constituted for the public good.

Civil government was instituted for the preservation and advancement of men's civil interests, and for the better security of their lives, liberties, and properties. The use and necessity of government is such, that there never was an age or country without some sort of civil authority; but as men are seldom unanimous in the means of attaining their ends, so their difference in opinion, in relation to government, has produced a variety of forms of it. To enumerate them would be to recapitulate the history of the whole earth. But they may, in general, be reduced to one of these heads; either the civil authority is delegated to one or more, or else it is still reserved to the whole body of the people; whence arises the known distinction of government into monarchy, aristocracy, and democracy.

The government of this country is unquestionably a mixed government, though by some writers it is denominated a limited monarchy. It is formed by a combination of the three regular species of government; the monarchy residing in the King, the aristocracy in the House of Peers, and the republic, being represented by the House of Commons.

GOUGE, an instrument or tool used by divers artificers; being a sort of round hollow chissel, for cutting holes, channels, grooves, &c. either in wood or stone.

GOURD. See CUCURBITA.

GOUT. See MEDICINE.

GRACE, *act of*, an act of parliament for a general and free pardon, and for setting at liberty insolvent debtors.

GRACE, *days of*, in commerce. See BILLS OF EXCHANGE.

GRACULA, the *grakle*, in natural history, a genus of birds of the order Picæ. Generic character: the bill convex, thick, sharp-edged, somewhat naked at the base; nostrils small, near the base of the bill; tongue entire, rather sharp at the end; claws hooked and sharp. No species of this bird is found in Europe. There are thirteen species, of which the following are the most remarkable: Gracula kelegiosa, or the minor grakle, is of the size of a blackbird, is found in various districts of the East Indies, and almost in every island beyond the Ganges. It is rendered familiar with the greatest ease, and readily taught to speak. The paradisœa tristis is rather larger than the former, and inhabits the Philippine islands.

Graculus quiscular, or purple grakle inhabits Carolina and other parts of North America, and is found also in the island of Jamaica, where it frequently makes great devastation in the maize fields. It is however found highly serviceable in devouring insects.

GRADUATE, a person who has taken a degree in the university.

GRADUATION, in mathematics, the act of graduating or dividing any thing into degrees, or equal parts.

GRAFTING, in gardening, is the insertion of a scion into a stock or stem raised for the purpose, and is necessary to the ensuring of good fruit, *i. e.* to have the same produced on the new tree, as that of the old one whence the graft was taken: it is sometimes performed on the branches of trees, and may be on the roots, a piece being raised out of the ground for the purpose.

The first thing to be done is, to cut off the head of the stock at the proper height, and in a fair part of the bark, making a smooth flat top. The most proper size for stocks, is from half an inch to an inch diameter.

Dwarf trees are to be grafted within six inches of the ground, and standards as high as the stock will well bear, considering whether they are to be half or full standards.

The scions should be healthy and strong, and taken from the outsides of fruitful trees, where the juices of the wood have been properly digested by sun and air; they should be taken from trees just in their prime, or at full bearing, and not before. Let them be cut two or three weeks sooner than wanted. The middle of scions are fittest for the purpose; but do not cut off the tops till they are brought out to graft, for they keep best in length. Take off a little of the lower end of the scion first, and then cut it in length, so as to have three or four eyes to appear above the claying: two eyes will be sufficient for a standard, but four are better for a dwarf that is to be trained.

The time for grafting is usually from mid-February to mid-March; but in a forward season sooner, and in a backward one sometimes later.

Cleft-grafting has been the most common method of propagation. The stocks for this mode of grafting should be strong, about three quarters of an inch diameter, or more; but it may be used with very young stocks, having scions of like thickness.

Cut off the head, as before directed, so as to have (on the sunny side) a smooth part in the stock, where the scion is to be placed, and cutting a part of the stock off slopewise, opposite to this place, leave the top or the crown of the stock, about the distance of half an inch wide. Then cleave the stock with a strong knife, or thin sharp chisel, about two inches deep, as near the middle as possible, so as not to divide the pith, and if any roughness appears in the slit, smooth it off with a penknife; but something of the wedge kind must be put into the slit to keep it open to receive the scion, leaving proper room to put it in. Cut the scion on each side to the form of a wedge at bottom, an inch or more long, making that side which is to be placed inwards in the stock, thinner by about one third. Put the scion in, so that its bark and that of the stock may be level, and consequently that the two barks may unite and run into each other; for on this one principle depends the whole art of grafting.

The graft must be nicely whipped round with wet bass pulled tight, and the whole clayed over to an inch above and half an inch below, smoothing it off taper, with a trowel or knife dipped in water.

Whip-grafting has the advantage of cleft-grafting in neatness, and not requiring the stocks to be so old by a year or two, as very small ones will do in this way; for the stock is directly covered by the scion, and it takes with certainty if properly performed.

Having cut the head of the stock off, and the scion to its proper length, slope the lower end of the scion about an inch and a half, and

to a point; then cut the stock to answer it. bark against bark, and tie them together exactly to their place, and clay it.

Grafting in the bark, or *crown-grafting*, is perhaps as good a way as any, both for ease of operation and certainty of success; but it will hardly suit any other fruit than apples or pears. The head being cut off, make a straight slit down through the bark from the top, at the place destined for the graft, nearly as long as the slope cut of the scion, which may be one and a half or two inches. Loosen the bark a little at the top of the score, and then with some smooth instrument open the bark sufficiently to receive the scion. This instrument should be thin, tapered and rounded towards the point, to suit the shape of the scion's face, one side of it flat, and the other a little convex, the flat side being applied to the wood of the stock; let it be rather narrower than the scion, that it may not loosen the bark too widely.

Cut a bit of the bark of the scion smooth off at the bottom that it may not turn up in pushing down. It will be proper to cut the scion with a small shoulder, to rest upon the stock. And because when the scion is in, it will bear the bark up hollow from the stock, score the bark each side the scion, so that it may fall close to the stock, and to the edges of the scion. Bind and clay neatly.

This way of grafting is used most properly with strong stocks; and sometimes is applied to large branches, and even trunks of old trees to change the sorts or renew the wood.

Side-grafting is done in the bark, much like inoculation, a scion being inserted instead of a bud; but remember, there must be a fluent sap first, i.e. the bark must part readily from the wood, before this mode of grafting is attempted. The head of the stock is not to be cut off, only thinned a little if it is large, and the side shoots taken away. The bark of the stock, where the insertion of the scion is to be, must be cut through in the form of the letter T, as wide and as long as is sufficient to receive the scion, cut as before, with a slope face of at least an inch long, taking advantage of a part of the stock that is a little gibbous. Let the bark of the stock be neatly raised to receive it, but yet no more than necessary; a little bit of the bark may be sliced off the part that is over the cross cut, to receive the scion the better.

Approach-grafting or *inarching*, is performed in April or May. When the stock we would graft, and the tree we would propagate, grow near together, bend the best situated young branch of the tree or shrub to be propagated, to the stock to be grafted, and having determined on the part at which most conveniently to fix the shoot, cut the bark of that part of the shoot off, with nearly half the wood (not to touch the pith) to the length of about three inches for a strong branch, or less for a weaker. Then cut exactly so much of the bark and branch of the stock off, as will receive the cut part of the branch or shoot, so as to bring bark and bark in contact in every part; and if the contrivance of lipping is used, it will secure them better together. Bind and clay, and if in open ground, fix a stake to tie the work so that the wind may have no power over it.

Budding or *inoculation*, though here last mentioned, is the most considerable mode of propagation.

Inoculation may be performed as soon as good shoots with good eyes of the present year can be had, so that the season may be reckoned from mid June to mid-August. Peaches and nectarines are propagated on plum-stocks. Plums and cherries may be inoculated on sucker stocks of any kind; but stocks raised from stones are best. Pears, if for standards, should be inoculated on pear stocks, and on those raised from seed, rather than suckers; but if for dwarfs, quince stocks may be best used, to keep the trees from growing off too fast.

Let the scions to procure buds for inoculation, be taken only from the outside branches of healthy and fruitful trees; but they must not be taken from the upper part of the scions, as the bark and buds there are too raw.

Before the buds are prepared, get the stock ready to receive them, by taking off lateral shoots, leaving an uncut single stem. At the part fixed on for the inoculation (which should be smooth, and rather on the north side) cut the bark through to the wood in the form of a T, the cross and the down slit being of the length necessary to take in the bud, which may be cut with from one to two inches of bark; putting the point of a knife (or some instrument rather not of iron or steel) into the top of the down cut of the stock, raise the bark all the way to the bottom, so that it will just receive the bud easily. There are knives made on purpose for budding, with flat ivory hafts.

To procure proper buds, put the knife in (suppose) about three-fourths of an inch above the eye, and with a slope downwards cut the scion half through, then do it at the same distance below the eye, and sloping it upwards cut up the middle of the wood, till the knife meets the upper incision, so the eye, or bud, will be directly in the middle.

Separate the wood from the bark, which is to be done thus: with your nail, or the point of a knife, loosen the bark at the top, and strip it from the wood; or rather with a swan or large goose quill, made in the form of an apple-scoop (having a regular smooth edge) push it down between the bark and wood, pressing it against the wood.

Examine the inside of the bark, and if there is a cavity just behind the eye or bud, it is good for nothing, and another must be procured.

The leaf that grows by the eye is to be cut down to near its footstalk, so as to leave only a little bit of it to hold the bud by.

See that the bark of the stock is loosened a proper length and breadth, and if, when the bud is put in, it should prove a little too long, cut the spare part off; so that the top of the bud being squared, falls in straight with the cross cut of the stock. Thus fixed, bind it moderately tight in its place, with the wet bass, beginning at the bottom, and passing by the bud, go on to the top, or rather above it. Care must be taken that the bud be not hurt, and it is to be left only just starting out between the bass.

If the buds have taken, it will be seen in about three weeks or a month, by their ap-

pearing fresh and plump. As often as any shoots appear below the budding, cut them off, and also some of the shoots above, if there are many of them: for it is not proper that an inoculated stock should have a large head. In a month loosen the bandage, by taking it off, and putting it on gently again for another month.

In March, cut the head of the stock off with a keen knife, close behind the budding, in a sloping direction. Suffer no shoots from the stock, but rub the buds off as soon as they appear. It may be of use to shade inoculated buds a few days by a leaf, or a bit of paper.

GRAIN, a small weight, the twentieth part of a scruple in apothecaries' weight, and the twenty-fourth of a pennyweight troy.

Grain also denotes the component particles of stones and metals, the veins of wood, &c Hence cross-grained, or against the grain, is contrary to the fibres of wood, &c.

GRAMMAR, may be defined to be the art of speaking or of writing any language with propriety. The term is commonly applied to a collection of observations called *rules*, to which the methods of speaking used in that language to which they belong may be reduced. For the sake of distinctness, writers on grammar usually divide the subject into four distinct heads, viz. *Orthography*, or the art of combining letters into syllables, and syllables into words; *Etymology*, or the art of deducing one word from another, and the various modifications by which the sense of any one word can be diversified consistently with its original meaning, or its relation to the theme whence it is derived; *Syntax*, which relates to the construction or right disposition of words into sentences or phrases; and *Prosody*, which treats of the quantities and accents of syllables, and the art of making verses.

To give even a general view of the grammar of our own language would far exceed our limits; nor, indeed, is any thing of this kind requisite, since the truly excellent works of Murray on the subject are in the hands of every student of English: to those, however, who are desirous of acquiring a thorough knowledge of that language, a careful perusal of that curious and entertaining work, "Tooke's Diversions of Purley," is indispensable.

GRAMME, in French weights. The unit weight, called a gramme, is the weight of the cube of the hundredth part of the metre of distilled water, taken at its maximum density. It answers to 15.444 grains.

GRANARY, a building to lay or store corn in, especially that designed to be kept a considerable time.

GRANATITE, *cross stone*, a mineral found in Spain, and in some parts of France and Switzerland. It is crystallized in a very peculiar form; two six-sided prisms intersect each other at right angles, or obliquely. Hence its name, cross stone. It is of a reddish brown colour; specific gravity 3.3, nearly. It is fusible before the blow-pipe.

GRAND *jury*, is the jury which find bills of indictment before justices of peace and gaol-delivery, or of oyer and terminer, &c. against any offenders that may be tried for the fact. See Jury.

GRANITE. A compound rock, consisting of quartz, felspar, and mica, each crystallized and cohering by mutual affinity, without any basis or cement. The felspar commonly predominates, and the mica is in smallest quantity. The colours of the felspar are white, red, grey, and green. The quartz is light grey, and the mica dark. The granular crystals vary exceedingly in size, in different granite rocks. Occasionally granite is stratified: but sometimes no stratification can be perceived. Large globular masses, called rolling stones, are frequently met with, composed each of concentric lamellar concretions. Schorl, garnet, and tinstone, are frequently present in granite. Tin and iron are the only metals abundantly found in this rock. It contains molybdena, silver, copper, lead, bismuth, arsenic, titanium, tungsten, and cobalt. It is, however, poorer in ores than many other rock formations.

GRANT, in law, a gift in writing of such a thing as cannot be passed or conveyed by word only, as a grant is the regular method, by the common law, of transferring the property of incorporeal hereditaments, on such thing whereof no livery of seisn can be had. For which reason, all corporeal hereditaments, as lands and houses, are said to be in livery; and the others, as advowsons, commons, services, rents, reversions, and the like, lie in grant. He that granteth is termed the grantor; and he to whom the grant is made is termed the grantee. A grant differs from a gift in this; that gifts are always gratuitous, grants are upon some consideration or equivalent. The operative words in grants are *dedi et concessi*, "I have given and granted." Grants may be void by incertainty, impossibility, being against law, or a wrong title, to defraud creditors, &c.

GRANULATION, the method of dividing metallic substances into grains or small particles, in order to facilitate their combination with other substances, and sometimes for the purpose of readily subdividing them by weight.

This is done either by pouring the melted metal into water, or by agitating it in a box until the moment of congelation, at which instant it becomes converted into a powder.

Various contrivances are used to prevent danger, and ensure success, in the several manufactories that require granulation. Copper is granulated for making brass, by pouring it through a perforated ladle into a covered vessel of water with a moveable false bottom. A compound metal, consisting chiefly of lead, is poured into water through a perforated vessel of another kind, for making small shot, in which the height above the surface of the fluid requires particular adjustment. In a new manufactory of this kind, the height is upward of 100 feet.

GRAPE. See Vitis.

Grape-*shot*, in artillery, a combination of small shot, put into a thick canvas bag, and corded strongly together, so as to form a kind of cylinder.

GRAPHITE, *Blacklead*, or *Plumbago*. See Plumbago.

GRAPHOMETER, is a name sometimes given to mathematical instruments similar to goniometers, or to particular modifications of the theodolite.

GRASS. For the culture of the different grasses. See AGRICULTURE.

GRASSHOPPER, in zoology. See GRYLLUS.

GRATIOLA, *hedge-hyssop,* a genus of the monogynia order, in the diandria class of plants. There are 12 species; the most remarkable of which is the officinalis, or common hedge-hyssop. This grows naturally in the Alps and other mountainous parts of Europe.

GRAVE, in music, is applied to a sound which is of a low or deep tone. The thicker the cord or string, the more grave is the note or tone: and the smaller, the more acute. The gravity of sounds depends on the slowness of the vibratory motions of the chord; and their acuteness on its quick vibrations.

GRAVE *accent,* in grammar, shews that the voice is to be lowered; its mark stands thus `.

GRAVE *digging beetle.* See SILPHA.

GRAVEL, in natural history and gardening, a congeries of pebbles, which, mixed with a stiff loam, makes lasting and elegant walks; an ornament peculiar to our gardens, and which gives them the advantage over those of other nations.

GRAVER, in the art of engraving, a tool by which all the lines, scratches, and shades, are cut in copper, &c.

GRAVIMETER. See HYDROMETER.

GRAVITATION. See ASTRONOMY.

GRAVITY *Specific.* See SPECIFIC GRAVITY.

GREAT-*circle sailing,* the manner of conducting a ship in, or rather pretty near, the arch of a great circle, that passes through the zenith of the two places, viz. whence she came, and to which she is bound.

GREEK *fire,* an invention of the middle ages, which enabled the Greeks for a time to resist the arms of the Mahometans. Asphaltum is supposed to have been its chief constituent, along with nitre and sulphur.

GREEN, one of the original colours excited by the rays of light. The green colour of plants has been shown, by the French chemists, to depend upon the absorption of carbonic acid, and it is supposed that the leaves of plants have the power of decomposing the carbonic acid and water also.

GREEN, *Brunswick.* It is made by saturating cold water with muriated ammonia, and adding three times as much copper clipping as ammonia. The moisture is to be evaporated, taking care that no dust be allowed to get to it. The muriate of ammonia is decomposed by the copper, which is itself corroded and converted into a green oxide. It is then to be digested in successive portions of alcohol, as long as any green oxide is taken up; the solutions are now to be added together, and the liquor to be driven off by a moderate heat; the residue is the pigment required.

GREEN *cloth,* a board or court of justice, held in the counting-house of the king's household, composed of the lord steward, and officers under him, who sit daily. To this court is committed the charge and oversight of the king's household in matters of justice and government, with a power to correct all offenders, and to maintain the peace of the verge, or jurisdiction of the court royal; which is every way about two hundred yards from the last gate of the palace where his Majesty resides. Without a warrant first obtained from this court, none of the king's servants can be arrested for debt.

GREEN-*finch.* See FRINGILLA.

GREEN-*house,* or conservatory, a house in a garden contrived for sheltering and preserving the most tender and curious exotic plants, which, in our climate, will not bear to be exposed to the open air during the winter season. These are generally large and beautiful structures, equally ornamental and useful.

GREGORIAN *calendar,* that which shews the new and full moon, with the time of Easter, and the moveable feasts depending thereon, by means of epacts, disposed through the several months of the Gregorian year.

GREGORIAN *epoch,* the epocha, or time whence the Gregorian calendar or computation took place. The year 1808 is the 226th year of that epocha.

GREGORIAN *year,* the Julian year corrected, or modelled, in such a manner as that three secular years, which in the Julian account are bissextile, are here common years, and only every fourth secular year is made a bissextile year.

The Julian computation is more than the solar year by eleven minutes, which in one hundred and thirty-one years amounts to a whole day. By this calculation, the vernal equinox was anticipated ten days from the time of the general council of Nice, held in the year 325 of the Christian æra, to the time of Pope Gregory XIII. who therefore caused ten days to be taken out of the month of October, in 1582, to make the equinox fall on the twenty-first of March, as it did at the time of that council, and to prevent the like variation for the future, he ordered that three days should be abated in every four hundred years, by reducing the leap-year at the close of each century for three successive centuries to common years, and retaining the leap-year at the close of each fourth century only. This was at that time esteemed as exactly conformable to the true solar year, but is is found not to be strictly just, because in 400 years it gets one hour and twenty minutes.

GREYWACKE. A mountain formation, consisting of two similar rocks, which alternate with, and pass into each other, called greywacke, and greywacke-slate. The first possesses the characters of the formation. It is a rock composed of pieces of quartz, flinty-slate, felspar, and clay-slate, cemented by a clay-slate basis. These pieces vary in size from a hen's egg to little grains. When the texture becomes exceedingly fine grained, the rock constitutes greywacke-slate. Its colour is usually ash or smoke-grey, without the yellowish-grey, or greenish tinge, frequent in primitive slate. It has not the continuous lustre of primitive slate, but glimmers from interspersed scales of mica. It contains quartz veins, but no beds of quartz. Petrefactions are found in it.

GRIFFON, in heraldry, an imaginary animal, feigned by the ancients to be half eagle and half lion; by this form they intended to give an idea of strength and swiftness joined

together, with an extraordinary vigilance in guarding the things entrusted to its care.

GRINDING, *trituratio*, the reducing hard substances to fine powders, either by the mortar, or by way of levigation, upon a marble.

GRISLEA, a genus of the monogynia order, in the octandria class of plants, and in the natural method ranking under the 17th order, calycanthemæ. There are two species; one a tree of South America, the other a shrub of the East Indies.

GRIST, in country-affairs, denotes corn ground, or ready for grinding.

GRIT, a genus of argillaceous earths. Its texture is more or less porous, equable, and rough to the touch. It does not give fire with steel, nor effervesce with acids. When fresh broken and breathed upon, it exhales an earthy smell.

GROSS, in law-books, signifies absolute or independent on another: thus, an advowson in gross, is one distinct and separate from the manor.

GROSS-*beak*, in ornithology. See LOXIA.

GROSS-*weight*, the whole weight of merchandizes, with their dust and dross; as also the bag or chest wherein they are contained. An allowance is usually made out of the gross-weight for tare and tret. See TARE.

GROTESQUE, in sculpture and painting, something whimsical, extravagant, and monstrous; consisting either of things that are merely imaginary, and have no existence in nature, or of things so distorted, as to raise surprize and ridicule.

GROTTO, a large deep cavern or den in a mountain or rock. The word is Italian, grotta; formed from the Latin crypta. The ancient anchorites retired into dens and grottos, to apply themselves the more attentively to meditation. Okey-hole, Elden-hound, Peake's-hole, and Pool's-hole, are famous among the natural caverns or grottos of our country.

The *Grotto del Cano*, situated about two miles from Naples, is celebrated for the noxious nature of the air contained in it, which is in fact carbonic acid gas. As this gas, from its weight, must always lie along the bottom of the cavern, small animals on entering must breathe it; whereas a man may traverse it in safety, as his head is considerably above the pestilential vapour. The height to which the gas rises may be seen from observing the colour of the sides of the cavern.

GROUND, in painting, the surface upon which the figures and other objects are represented. See PAINTING.

GROUP, in painting and sculpture, is an assemblage of two or more figures of men, beast, fruits, or the like, which have some apparent relation to each other.

GRUB, the name of worms produced from the eggs of beetles, which are at length transformed into winged insects of the same species with their parents.

GROUSE, a species of the TETRAO, which see.

GRUINALES, in botany, the name of the fourteenth order of Linnæus's Fragments. This order furnishes both herbaceous and woody plants. The roots are sometimes fibrous, and sometimes tuberous. In some species of the oxalis, wood sorrel, they are jointed; the stems are cylindric, and the young branches in some nearly square; the buds are of a conic form, covered with scales; the leaves in some genera are simple, in others compound; the flowers are hermaphrodite. In this order are the geranium, crane's-bill; linum, flax; oxalis, wood-sorrel; guiacum, lignum-vitæ.

GRUS, the *crane*. See ARDEA.

GRYLLUS, in natural history, the *locust*, *grasshopper*, and *cricket*, a genus of insects belonging to the order hemiptera. Generic character: head inflected, armed with jaws, and furnished with feelers: antenna, in most species, either filiform or setaceous; wings four, deflex, convoluted: lower wings plaited; hind legs formed for leaping; claws double on all the feet. There are sixty-one species.

Among the most numerous species is the gryllus migratorius of Linnæus, or common migratory locust. Legions of these animals are from time to time observed in various parts of the world, where the havock they commit is almost incredible: whole provinces are in a manner desolated by them in the space of a few days, and the air is darkened by their numbers: nay, even when dead, they are still terrible; since the putrefaction arising from their inconceivable number is such, that it has been regarded as one of the probable causes of pestilence in the eastern regions.

One of the largest species of locust yet known is the *grillus cristatus* of Linnæus, which is five or six times the size of the gryllus migratorius; and, together with some others of the larger kind, is made use of in various parts of the world as an article of food.

The *gryllus viridissimus* of Linnæus is one of the largest European species, and is often seen during the decline of summer in our own country.

The *gryllus gryllotalpa*, or mole-cricket, is the most curious; and in its colour and manners differs greatly from the rest. It is of an uncouth and even formidable aspect, measuring more than two inches in length, its fore-legs are furnished with very broad feet, divided into several sharp claw-shaped segments, with which it is enabled to burrow under ground; it emerges from its subterraneous retreats only by night, when it creeps about the surface, and occasionally employs its wings in flight. The mole-cricket lives entirely on vegetables, devouring the young roots of grasses, &c. and commits great devastation in gardens.

G. *tettigonia* or grasshopper, well known in our meadows, and the *acheta* or hearth cricket, belong to this genus.

GUAIACUM. A resinous looking substance, extracted from the very dense wood of a tree growing in the West Indies, called *guaiacum officinale*. It differs however from resins in its habitudes with nitric acid, as Mr. Hatchett first shewed. Its specific gravity is 1.229. Its colour is yellowish-brown, but it becomes green on exposure to light. It is transparent, and breaks with a resinous fracture. Its odour is not disagreeable, but when a very little of its powder, mixed with water, is swallowed, it excites a very unpleasant burning sensation in the fauces and stomach. Heat fuses it, with the exhalation of a somewhat fragrant smell. Water dissolves a certain portion of it, acquiring a brownish tinge, and sweetish taste. The soluble matter is left when the water is

evaporated. It constitutes 9 per cent of the whole, and resembles what some chemists call extractive.

Guaiacum is very soluble in alcohol. This solution, which is brown-coloured, is decomposed by water. Aqueous chlorine throws down a pale blue precipitate from it.

Guaiacum dissolves readily in alkaline leys, and in sulphuric acid; and in the nitric with effervescence. From the solution in the last liquid, oxalic acid may be procured by evaporation, but no artificial tannin can be obtained, as from the action of nitric acid on other resins.

Formerly guaiacum was much commended in siphilis and other complaints; at present it is used chiefly in rheumatism, dissolved in liquid ammonia.

GUANO. A substance found on many of the small islands on the South Sea, which are the resort of numerous flocks of birds, particularly of the ardea and phœnicopteros genus. It is dug from beds 50 or 60 feet thick, and used as a valuable manure in Peru, chiefly for Indian corn. It is of a dirty yellowish colour, nearly insipid to the taste, but has a powerful smell partaking of castor and valerian. According to the analysis of Fourcroy and Vauquelin, about one-fourth of it is uric acid, partly saturated with ammonia and lime. It contains likewise oxalic acid, partly saturated with ammonia and potash; phosphoric acid combined with the same bases and with lime; small quantities of sulphate and muriate of potash, and ammonia; a small portion of fat matter; and sand, partly quartzose, partly ferruginous.

GUARD, in a general sense, signifies the defence or preservation of any thing; the act of observing what passes, in order to prevent surprise; or the care, precaution, and attention we make use of, to prevent any thing happening contrary to our intention.

Guard, in the military art, is a duty performed by a body of men, to secure an army or place from being surprised by an enemy.

Guard, *advanced*, is a party of either horse or foot, that marches before a more considerable body, to give notice of approaching danger.

Guard-*boat*, a boat appointed to row the rounds among the ships of war in any harbour, to observe that their officers keep a good look-out, calling to the guard-boat as she passes, and not suffering her crew to come on board, without having previously communicated the watch-word of the night.

Guard-*ship*, a vessel to superintend the marine affairs in a harbour or river, and to see that the ships which are not commissioned have their proper watch duly kept; she is also to receive seamen who are impressed in time of war; she generally has an admiral's flag at one of her mast's head.

Guard, in fencing, is a posture proper to defend the body from an enemy's sword.

There are four general guards of the sword; to form a perfect idea of which, we must suppose a circle drawn on a wall, and divided into four cardinal points, *viz.* top and bottom, right and left. When the point of the sword is directed to the bottom of the circle, with the hilt opposite to its top, the body inclining very forward, this is called the prime or first guard. The second guard is, when the point is directed to the right or second point of the same circle, with the hilt of the sword turned to the left, and the body proportionably raised. The tierce, or third guard, is when the point of the sword is raised to the uppermost part of the same circle; in which case the body, the arm, and the sword, are in their natural position, and in the mean of the extremes of their motion. The quart, or fourth guard, is when the point of the sword is directed to the fourth point of the circle, descending to the right as far as one fourth of the tierce, with the outward part of the arm and the flat of the sword turned towards the ground, and the body out of the line to the right, and the hilt of the sword towards the line to the left. There is also a quint, or fifth guard, which is only the return of the point of the sword to the right, after traversing the circle to the point of the prime, from whence it had departed, with a different disposition of the body, arm, and sword. The common centre of all those motions ought to be in the shoulder.

GUARDIAN, one appointed by the wisdom and policy of the law, to take care of a person and his affairs, who by reason of his imbecility and want of understanding, is incapable of acting for his own interest.

There are several kinds of guardians, as, guardian by nature, guardian by the common law, guardian by statute, guardian by custom, guardian in chivalry, guardian in soccage, and guardian by appointment of the Lord Chancellor.

Guardian, *by nature*, is the father or mother: and by the common law every father has a right of guardianship of the body of his son and heir, until he attains the age of twenty-one years.

This guardianship extends no farther than the custody of the infant's person.

The father may disappoint the mother, and other ancestors, of the guardianship by nature, by appointing a testimentary guardian

Guardian, *by the common law.* If a tenant in soccage dies, his heir being under fourteen, whether he is his issue or cousin, male or female, the next of blood to the heir, to whom the inheritance cannot descend, shall be guardian of his body and land till the age of fourteen: the heir after fourteen may choose his own guardian, who shall continue till he is twenty-one.

Guardian, *by the statute.* The principal guardianship is now by the statute 12 Charles II. c. 24, by which any father, under or of full age, may by deed or will, attested by two witnesses, appoint, dispose of the custody of his child born or unborn to any person except a popish recusant convict, either in possession or reversion till such child attain twenty-one. This guardian supersedes the guardian in soccage, and has all actions which that guardian might have had. Besides which he has the care of the estate, real and personal. A father cannot under this statute appoint one to his natural child, and a case has been decided upon the marriage act, in which a marriage with consent of a guardian applied to a natural child was held void. The chancellor, however, will upon application appoint the same person guardian.

Guardian, *by appointment of the Lord Chancellor.* The Court of Chancery is the only proper court that hath jurisdiction in appointing and removing guardians, and in preventing them and others from abusing their persons or

estates. And as the Court of Chancery is now vested with this authority, we find that court determining, as to the right of guardianship, who is the next of kin, and who the most proper guardian; also orders are made by that court on petition or motion, for the provision of infants during any dispute therein; likewise guardians removed or compelled to give security: they and others punished for abuses committed on infants, and effectual care taken to prevent any abuses intended them in their persons or estates. All courts of justice appoint guardians to infants, to see and prosecute their rights in their respective courts, when the occasion calls for it.

There are also some cases where an infant may elect a guardian, and the Court of Chancery allows him to do so after fourteen.

GUARDIAN *of the Spiritualities*, is he to whom the spiritual jurisdiction of any diocese is committed, during the vacancy of the see. The archbishop is guardian of the spiritualities, on the vacancy of any see within his province.

GUILD (from the Saxon guildan " to pay,") signifies a fraternity or company, because every one was gildare, that is, to pay something towards the charge and support of the company. As to the original of these guilds or companies, it was a law among the Saxons, that every freeman of fourteen years of age should find sureties to keep the peace, or be committed: upon which certain neighbours, entered into an association, and became bound for each other, either to produce him who committed an offence, or to make satisfaction to the injured party; that they might the better do this, they raised a sum of money among themselves, which they put into a common stock. These guilds are now companies joined together, with laws and orders made by themselves, by the licence of the prince.

GUITAR, or GUITARRA, a musical instrument of the string-kind, with five double rows of strings, of which those that are bass, are in the middle, unless it be for an octave lower than the fourth.

GULA, or GOLA. See ARCHITECTURE.

GULES, in heraldy, signifies the colour red, which is expressed in engraving by perpendicular lines falling from the top of the escutcheon to the bottom.

GUM. The mucilage of vegetables. The principal gums are, 1. The common gums obtained from the plum, the peach, the cherry tree, &c. 2. Gum Arabic, which flows naturally from the acacia in Egypt, Arabia, and elsewhere. This forms a clear transparent mucilage with water. 3. Gum Seneca, or Senegal. It does not greatly differ from gum Arabic; the pieces are larger and clearer; and it seems to communicate a higher degree of the adhesive quality to water. It is much used by calico-printers and others. The first sort of gums are frequently sold by this name, but may be known by their darker colour. 4. Gum Adragant or Tragacanth. It is obtained from a small plant of the same name growing in Syria, and other eastern parts. It comes to us in small white contorted pieces resembling worms. It is usually dearer than other gums, and forms a thicker jelly with water.

Mr. Willis has found that the root of the common blue-bell *hyacinthus non scriptus*, dried and powdered, affords a mucilage possessing all the qualities of that from gum Arabic. Lord Dundonald has extracted a mucilage also from lichens.

Gums treated with nitric acid afford the acid of sugar. See APPENDIX.

GUM *Elastic*. See CAOUTCHOUC.

GUM *Resin*. The principal gum resins are frankincense, scammony, asafœtida, aloes, gum ammoniac, and gamboge.

GUN, a fire arm or weapon of offence, which forcibly discharges a ball, shot, or other offensive matter, through a cylindrical barrel, by means of gunpowder. Gun is a general name, under which are included divers, or even most species of fire arms. They may be divided into great and small.

Great guns, called also by the general name cannons, make what we also call ordnance or artillery; under which come the several sorts of cannon.

GUNDELIA, a genus of the class and order syngenesia polygamia segregata. There is one species, an herb of the Levant, having the habit of a thistle.

GUNNERA, a genus of the class and order gynandria diandria. There is one species, a herb of the Cape.

GUNNERY, is the art of determining the course and directing the motion of bodies shot from artillery, or other warlike engines.

The great importance of this art is the reason it is distinguished from the doctrine of projectiles in general; for it is no more than an application of those laws which all bodies observe when cast into the air, to such as are put in motion by the explosion of guns or other engines of that sort.

Although numerous experiments had been tried on the subject of gunnery, no general principle seems to have been established from them, till Mr. Benjamin Robins, in 1742, published his *New Principles of Gunnery, containing the determination of the force of Gunpowder, and the investigation of the differences in the resting power of the air to swift and slow motions*. The following are the principal of the practical maxims of that eminent artificer, relative to the effects and management of artillery, the flight of shot and shells.

Maxim 1. In any piece of artillery whatever, the greater quantity of powder it is charged with, the greater will be the velocity of the bullet.

2. If two pieces of the same bore, but of different lengths, are fired with the same charge of powder, the longer will impel the bullet with a greater celerity than the shorter.

3. If two pieces of artillery different in weight, and formed of different metals, have their cylinders of equal bores and equal lengths; then, with like charges of powder, and like bullets, they will each of them discharge their shot with nearly the same celerity.

4. The ranges of pieces at a given elevation, are no just measure of the velocity of the shot, for the same pieces fired successively at an invariable elevation with the powder, bullet, and every other circumstance as nearly the same as possible, will range to different distances.

5. The greatest part of that uncertainty in the range of pieces, arises from the resistance of the air.

6. The resistance of the air acts upon the

projectiles in a two-fold manner. for it opposes their motion, and by that means continually diminishes their celerity; and it, besides, perpetually diverts them from the regular course they would otherwise follow.

7. If the same piece of cannon be successively fired at an invariable elevation, but with various charges of powder, the greatest charge being the whole weight of the bullet in powder, and the least not less than the fifth of that weight; then if the elevation be not less than 8° or 10°, it will be found that some of the ranges with the least charge will exceed some of those with the greatest.

8. If two pieces of cannon of the same bore, but of different lengths, are successively fired at the same elevation. with the same charge of powder, then it will frequently happen that some of the ranges with the shorter piece will exceed some of those with the longer.

9. In distant cannonadings, the advantages arising from long pieces and large charges of powder, are but of little moment.

10. Whatever operations are to be performed by artillery, the least charges of powder with which they can be effected are always to be preferred.

11. No field-piece ought at any time to be loaded with more than one sixth, or at the utmost one fifth of the weight of its bullet in powder. Nor should the charge of any battering piece exceed one third of the weight of its bullet.

12. The depth to which a bullet penetrates in a solid substance is a much more definite criterion of its comparative velocity than the distance to which it ranges when fired at an elevation; for with different velocities, the penetrations vary in a much greater proportion than the velocities themselves.

For the demonstration of this, Mr. Robins invented a machine which simply consists of a pendulous block of wood suspended freely by a horizontal axis, against which block the balls are fired.

GUNPOWDER. This well known powder is composed of 75 parts, by weight, of nitre, 16 of charcoal, and 9 of sulphur, intimately blended together by long pounding in wooden mortars, with a small quantity of water. This proportion of the materials is the most effectual. But the variations of strength in different samples of gunpowder are generally occasioned by the more or less intimate division and mixture of the parts. The reason of this may be easily deduced from the consideration, that nitre does not detonate until in contact with inflammable matter; whence the whole detonation will be more speedy, the more numerous the surfaces of contact. The same cause requires that the ingredients be very pure, because the mixture of foreign matter not only diminishes the quantity of effective ingredients which it represents, but likewise prevents the contacts by its interposition.

The nitre of the third boiling is usually chosen for making gunpowder, and the charcoal of light woods is preferred to that of those which are heavier, most probably because this last, being harder, is less pulverable.

The requisite pounding of the materials is performed in the large way, by a mill, in which wooden mortars are disposed in rows, and in each of which a pestle is moved by the arbor of a water-wheel: it is necessary to moisten the mixture from time to time with water, which serves to prevent its being dissipated in the pulverulent form, and likewise obviates the danger of explosion from the heat occasioned by the blows. Twelve hours' pounding is in general required to complete the mixture; and when this is done, the gunpowder is in fact made, and only requires to be dried to render it fit for use.

The granulation of gunpowder is performed by placing the mass, while in the form of a stiff paste, in a wire sieve, covering it with a board, and agitating the whole: by this means it is cut into small grains or parts, which, when of a requisite dryness, may be rendered smooth or glossy by rolling them in a cylindrical vessel or cask. Gunpowder in this form takes fire more speedily than if it be afterward reduced to powder, as may be easily accounted for from the circumstance, that the inflammation is more speedily propagated through the interstices of the grains. But the process of granulation does itself, in all probability, weaken the gunpowder, in the same manner as it is weakened by suffering it to become damp; for, in this last case, the nitre, which is the only soluble ingredient, suffers a partial solution in the water, and a separation in crystals of greater or less magnitude; and accordingly the surfaces of contact are rendered less numerous.

GUNTER'S *chain*, the chain in common use for measuring land, according to the true or statute measure; so called from Mr. Gunter its inventor.

The length of the chain is 66 feet, or 22 yards, or four poles of five yards and a half each; and it is divided into 100 links, of 7.92 inches each.

This chain is the most convenient of any thing for measuring land, because the contents thence computed are so easily turned into acres. The reason of which is, that an acre of land is just equal to 10 square chains, or 10 chains in length and one in breadth, or equal to 100,000 square links. Hence the dimensions being taken in chains, and multiplied together, it gives the content in square chains; which therefore being divided by 10, or a figure cut off for decimals, brings the content to acres; after which the decimals are reduced to roods and perches, by multiplying by 4 and 40.

GUNTER'S *line*, a logarithmic line, usually graduated upon scales, sectors, &c. It is also called the line of lines, and line of numbers. It is usually divided into a hundred parts, every tenth of which is numbered, beginning with 1, and ending with 10; so that if the first great division, marked 1, stand for one-tenth of any integer, the next division, marked 2, will stand for two-tenths; 3, three-tenths, and so on; and the intermediate divisions will, in like manner, represent 100th parts of some integer. If each of the great divisions represent 10 integers, then will the lesser divisions stand for integers; and if the great divisions be supposed each 100, the subdivisions will be each 10.

USE OF GUNTER'S LINE.

1. *To find the product of two numbers.* From 1 extend the compasses to the multiplier and the same extent, applied the same way from the multiplicand, will reach to the product. Thus, if the product of 4 and 8 be re-

quired, extend the compasses from 1 to 4 and that extent laid from 8 the same way, will reach to 32, their product.

2. *To divide one number by another.* The extent from the divisor to unity will reach from the dividend to the quotient: thus to divide 36 by 4, extend the compasses from 4 to 1, and the same extent will reach from 36 to 9, the quotient sought.

3. *To three given numbers, to find a fourth proportional.* Suppose the numbers 6, 8, 9; extend the compasses from 6 to 8, and this extent, laid from 9 the same way, will reach to 12, the fourth proportional required.

4. *To find a mean proportional between any two given numbers.* Suppose 8 and 32: extend the compasses from 8 in the left-hand part of the line, to 32 in the right; then bisecting this distance, its half will reach from 8 forward, or from 32 backward, to 16 the mean proportional sought.

5. *To extract the square root of any number.* Suppose 25: bisect the distance between 1 on the scale and the point representing 25; then the half of this distance, set off from 1, will give the point representing the root 5. In the same manner the cube root, or that of any higher power, may be found by dividing the distance on the line, between 1 and the given number, into as many equal parts as the index of the power expresses; then one of those parts, set from 1, will find the point representing the root required.

Gunter's *quadrant*, one made of wood, brass, &c. containing a kind of stereographic projection of the sphere, on the plane of the equinoctial; the eye being supposed placed in one of the poles.

Besides the use of this quadrant in finding heights and distances, it serves also to find the hour of the day, the sun's azimuth, and other problems of the globe.

Gunter's *scale*, usually called by seamen *the Gunter*, is a large plane scale having various lines upon it, of great use in working the cases or questions in navigation.

This scale is usually two feet long, and about an inch and a half broad, with various lines upon it, both natural and logarithmic, relating to trigonometry, navigation, &c.

On one side are the natural lines, and on the other the artificial or logarithmic ones. The former side is first divided into inches and tenths, and numbered from 1 to 24 inches, running the whole length near one edge. One-half the length of this side consists of two plane diagonal scales, for taking off dimensions to three places of figures. On the other half or foot of this side are contained various lines relating to trigonometry, in the natural numbers, and marked thus, viz.

Rumb. the rumb or points of the compass;
Chord. the line of chords;
Sine, the line of sines;
Tang. the tangents;
S. T. the semitangents; and at the other end of this half are,
Leag. leagues, or equal parts,
Rumb. another line of rumbs;
M. L. miles of longitude:
Chor. another line of chords.

Also in the middle of this foot are *L.* and *P.* two other lines of equal parts. And all these lines, on this side of the scale, serve for drawing or laying down the figures to the cases in trigonometry and navigation.

On the other side of the scale are the following artificial or logarithmic lines, which serve for working or resolving those cases, viz.

S. R. the sine rumbs;
T. R. the tangent rumbs;
Numb. line of numbers;
Sine, sines;
V. S. the versed sines;
Tang. the tangents;
Meri. meridional parts;
E. P. equal parts.

GUN-*wale*, or *gunnel*, is the uppermost wale of a ship, or that piece of timber which reaches on either side from the quarter-deck to the forecastle.

GUST, in sea-language, a sudden and violent squall of wind, bursting from the hills upon the sea, so as to endanger the shipping near the shore.

GUTTA-*serena*, a disease in which the patient, without any apparent fault in the eye, is entirely deprived of sight.

GUTTY, in heraldry, a term used when any thing is charged or sprinkled with drops.

GUY, in a ship, is any rope used for keeping off things from bearing or falling against the ship's sides when they are hoisting in.

GYMNASTICS. This word, derived from the Greek, comprehends all those athletic exercises by which the ancients rendered the body pliant and healthy, and enabled the muscles to do their offices with treble effect. Several very respectable works on the subject of gymnastic exercises have recently appeared, which, it is hoped, will tend much to excite a spirit for that manly and healthful exercise of the physical powers, for which the Greeks and Romans were so celebrated, and banish for ever from the Island, the brutal taste for prize-fighting, which has so long disgraced the English name.

GYMNOTUS, the *gymnote*, in natural history, a genus of fishes of the order Apodes. This fish, which is found in the hot climates of Africa and America, and in the rivers of Surinam and Senegal, is noted for its possessing the remarkable quality of communicating to the person who touches it a very sudden and violent shock, resembling that experienced from the voltaic apparatus.

The following interesting account of this fish we copy from the Edinburgh Philosophical Journal, No. 21.

Structure of Electric Organs of Gymnotus Electricus.

On each side there is an upper large, and an under small electric organ. The large organ arises immediately behind the head, under the great dorsal muscles, where it is obtuse and gradually becomes narrower, and terminates acutely towards the end of the tail. It is straight, or somewhat hollowed towards the back-bone, but convex in the opposite direction: above, it terminates in a line; in a nearly similar manner below, and is thickest in the middle.

It is composed of horizontal plates, about the third of a line from each other, which are traversed at right angles by partition walls, and in the small space between them water is contained. Below this large organ lies a similar,

but smaller and more minutely divided one. These parts are supplied with numerous intercostal nerves: in the specimen examined by Rudolphi, 224, were observed on each side. A great branch of the third branch of the fifth pair of nerves, augmented by a smaller branch from the vagus, runs parallel with the backbone, from the head to the tail, where it divides. This nerve runs immediately over the intercostal nerves, and crosses them at right angles, without, however, uniting with them in any way; on the contrary, they are entirely distributed to the muscles of the back. This is the nerve which Hunter describes as the vagus, and which Fahlberg erroneously considered as the electric nerves; while Hunter, with his usual accuracy, describes the intercostal nerves as those of the electric organs. If we compare the electric organs of the torpedo and gymnosus electricus, the first may be compared with the voltaic pile, the second with the trough apparatus. But they agree in their principal feature, viz. in the abundant distribution of nerves to very vascular plates between which a serous fluid is disposed.

GYMNETRUS, a genus of fishes, of the order of thoracici. The generic character is, body extremely long, compressed; teeth numerous, subulate; gill membrane, four or five-rayed; anal fin wanting. The most remarkable species is gymnetrus Ascanii, or Ascanian gymnetrus.

This fish is said to be generally seen either preceding or accompanying the shoals of herrings in the northern seas, for which reason it is popularly known by the title of king of the herrings.

GYNANDRIA, *from γυνη, a woman,* and *ανηρ, a man,* the name of the 20th class in Linnaeus's sexual system, consisting of plants with hermaphrodite flowers, in which the stamina are placed upon the style, or, to speak more properly, upon a pillar-shaped receptacle resembling a style, which rises in the middle of the flower, and bears both the stamina and pointal; that is, both the supposed organs of generation. The flowers of this class, says Linnaeus, have a monstrous appearance; arising as he imagines, from the singular and unusual situation of the parts of fructification.

GYPSIES, are wandering tribes who live, in general, in the most extreme state of wretchedness, and seem to hold in contempt every thing that has a tendency to raise human beings above the state of absolute barbarism. They are very numerous on the Continent; in England much less so; and in Scotland they are now extremely few. Their origin, although generally supposed to be Egyptian, is involved in great obscurity. In this country, as well as on the Continent, their general *profession* is that of working in iron and brass, which is only a sort of cover for the manner in which they obtain their living. It is, however, but justice to state, that at present many of them, particularly in the midland counties of England, are regularly licensed hawkers, who although they still keep themselves distinct in society, exhibit many proofs of industry, and in the winter season reside in towns, and send their children to school; from which circumstances it may rationally be expected that they will gradually become incorporated with civilized society.

GYPSUM, a substance well known to the ancients, and one that is very abundant in nature, and is now denominated, according to the new chemical arrangement, the sulphate of lime. It forms immense strata, composing entire mountains; it is found in almost every soil; it is contained in the waters of the ocean, and in almost all river and spring water. In these its presence is the cause of the quality termed hardness, which may be known by the water being incapable of forming a solution of soap, the sulphuric acid seizing on the alkali of the soap, and the oil forming a compound with the lime. Sulphate of lime is insipid, white, and soft to the touch. Water will not hold a 500th part of it in solution. Exposed to heat it appears to effervesce, which phenomenon is caused by the expulsion of water. It becomes opaque, and falls into powder. This powder, when its water has been driven off by the application of a red heat, absorbs water rapidly, so that if it be formed into a paste with water, it dries in a few minutes. In this state it is called plaster of Paris, and is employed for forming casts, and for a variety of purposes in the art of statuary.

GYRINUS, the *water-flea,* a genus of insects of the order coleoptera. The natator, or common water flea, is of a bright black colour; the feet are yellow, flat, and large; the length of the insect is about one third of an inch. It runs with great celerity on the surface of the water, and is caught with great difficulty, plunging down instantaneously when attempted to be taken. There are eight other species, which frequent the waters in different parts of the world.

H.

H. This letter is the eighth in the English alphabet. By some it is denied the place of a consonant; but it evidently performs, in numerous instances, the office of one. It is used as a numeral, to denote 200; and with a dash over it, it denotes 200,000.

HABEAS *corpus,* a writ of various uses, and of different importance. It was originally a writ, which a man indicted of a trespass before justices of the peace, or in a court of franchise, and being apprehended for it, may have out of the King's Bench, to remove himself thither at his own costs, and to answer the cause there. In its more usual sense it is the most celebrated writ in the English law. The most efficacious kind, in all manner of illegal confinement, is that of *habeas corpus ad subjiciendum,* which is the subject's writ of right, in cases where he is aggrieved by illegal imprisonment, or any unwarrantable exercise of power.

This writ is founded upon common law, and has been secured by various statutes, of which the last and most efficacious, was 31 Charles II

c. 2, which is emphatically termed the habeas act, and may justly be deemed a second magna charta, and, as relates to modern times, is far more efficacious, for it is the grand protection of the subject against unlawful imprisonment.

HABIT, in philosophy, an aptitude or disposition either of mind or body, acquired by a frequent repetition of the same act.

HACKLE, an implement used in dressing flax.

HADDOCK. See GADUS.

HÆMANTHUS, the *blood flower*, a genus of the monogynia order, in the hexandria class of plants, and in the natural method ranking under the ninth order, spathaceæ. The involucrum is hexaphyllous and multiflorous; the corolla sexpartite, superior; the berry trilocular. There are eight species.

HÆMANTHUS, in botany, a genus of the hexandria monogynia class and order. Natural order of spathaceæ. Essential character; involucre six-leaved, many-flowered; coralla six-parted, superior; berry three-celled. There are eight species.

HÆMATOPUS, the *oyster-catcher*, in natural history, a genus of birds of the order Grallæ. Generic character: bill compressed, the tip an equal wedge: nostrils linear; tongue about third part of the length of the bill; toes three; all placed forwards, the outer one joined to the middle by a strong membrane. This bird is sixteen inches in length, and about the size of a crow; it is to be met with on almost every sea-shore, and is rather common in Great Britain, particularly on the Western coast.

HÆMATOXYLUM, *logwood*, or *Campeachy wood*, a genus of the monogynia order, in the decandria class of plants, and in the natural method ranking under the 33d order, lomentaceæ. Of this genus there is only one species, viz. the Campechianum, which grows naturally in the bay of Campeachy at Honduras, and other parts of the Spanish West Indies, where it rises from 16 to 24 feet high.

HÆMORRHAGE, in medicine, a flux of blood from any part of the body.

HÆRUCA, in entomology, a genus of the order of vermes intestina. The body is round, the forepart two-necked, and surrounded with a single row of prickles. The H. muris is grey-white and wrinkled; it inhabits the intestines of the mouse, and is distinguished from the echinorhynchus, in wanting the retractile proboscis.

HAIL, a meteor generally defined frozen rain, but differing from it in that the hailstones are not formed of single pieces of ice, but of many little spherules agglutinated together. Neither are these spherules all of the same consistence; some of them being hard and solid like perfect ice; others soft, and mostly like snow hardened by a severe frost. Sometimes the hailstone has a kind of core of this soft matter; but more frequently the core is solid and hard, while the outside is formed of a softer matter. Hailstones assume various figures, being sometimes round, at other times pyramidal, crenated, angular, thin, and flat, and sometimes stellated, with six radii like the small crystals of snow.

HAILING, in naval language, the salutation or accosting a ship at a distance, which is usuallpe yrformed with a speaking-trumpet; the first exclamation is "hoa, the ship, a hoay," to which she replies "holloa;" then follow the requisite questions and replies.

HAIR, small filaments issuing out of the pores of the skins of animals, and serving most of them as a tegument or covering. In lieu of hair, the nakedness of some animals is covered with feathers, wool, scales, &c. Hair is found on all parts of the human body, except the soles of the feet and the palms of the hands; but it grows longest on the head, chin, breast, in the armpits, &c. It is known that every hair does properly and truly live, and receive nutriment to fill and distend it like the other parts; which they argue hence, that the roots do not turn grey in aged persons sooner than in young persons.

It may be observed, however, that, in propriety, the life and growth of hairs is of a different kind from that of the rest of the body, and is not immediately derived therefrom, or reciprocated therewith. It is rather of the nature of vegetation. They grow as plants do out of the earth; or, as some plants shoot from the parts of others, from which though they draw their nourishment, yet each has, as it were, its several life, and a distinct economy. They derive their food from some juices in the body, but not from the nutritious juices; whence they may live though the body be starved.

The hairs ordinarily appear round or cylindrical; but the microscope also discovers triangular and square ones, which diversity of figure arises from that of the pores, to which the hairs always accommodate themselves. Their length depends on the quantity of the proper humour to feed them, and their colour on the quality of that humour, whence, at different stages of life, the colour usually differs. Their extremities split into two or three branches, especially when kept dry, or suffered to grow too long, so that what appears only a single hair to the naked eye, seems a brush to the microscope. From numerous experiments M. Vauquelin infers, that black hair is formed of nine different substances, namely:

1. An animal matter, which constitutes the greater part. 2. A white concrete oil in small quantity. 3. Another oil of a greyish green colour, more abundant than the former. 4. Iron, the state of which in the hair is uncertain. 5. A few particles of oxide of manganese. 6. Phosphate of lime. 7. Carbonate of lime, in very small quantity. 8. Silex, in a conspicuous quantity. 9. Lastly, a considerable quantity of sulphur.

The same experiments shew, that red hair differs from black only in containing a red oil, instead of a blackish-green oil: and that white hair differs from both these only in the oil being nearly colourless, and in containing phosphate of magnesia, which is not found in them.

HAIR, or DOWN, *of plants*, a general term, expressive of all the hairy and glandular appearances on the surface of plants, to which they are supposed by naturalists to serve the double purpose of defensive weapons and vessels of secretion. These hairs are minute threads, of greater or less length and solidity, some of them visible to the naked eye, whilst others are rendered visible only by the help of glasses.

HAIR'S *breadth*, a measure of length, being the forty-eighth part of an inch.

HAKE, in ichthyology, the English name of the gadus, with two fins on the back, and the under-jaw longest. It grows to two feet or more in length, but is the slenderest of all the gadi. See GADUS.

HALBARD, or *halbert*, in the art of war, a well-known weapon, carried by the serjeants of foot and dragoons. It is a sort of spear, the shaft of which is about five feet long, and made of ash or other wood. Its head is armed with a steel point, edged on both sides, not unlike the point of a two-edged sword: but besides this sharp point, which is in a line with the shaft, there is a cross piece of steel, flat and pointed at both ends; but generally with a cutting edge at one extremity, and a bent sharp point at the other; so that it serves equally to cut down, or thrust.

HALF-*moon*, in fortification, an out-work composed of two faces, forming a saliant angle, whose gorge is in form of a crescent, or half-moon.

HALIOTIS, the ear-shell, a genus of insects belonging to the order of vermes testacea. This is an animal of the snail kind, with an open shell resembling an ear. There are nineteen species, distinguished by the figure of their shells.

HALLERIA, a genus of the angiospermia order, in the didynamia class of plants; and in the natural method ranking under the 40th order, personatæ. There is one species, a shrub of the Cape.

HALLIARDS, in sea language, the ropes or tackles usually employed to hoist or lower any sail upon its respective masts or stay.

HALO, in physiology, a meteor in the form of a luminous ring or circle, of various colours, appearing round the bodies of the sun, moon, or stars. See METEOROLOGY.

HAMMER, a well-known tool used by mechanics, consisting of an iron head, fixed crosswise upon a handle of wood.

HAMMOCK, in naval affairs, a piece of hempen cloth six feet long and three feet wide, gathered together at the two ends by means of a clue, and slung horizontally under the deck, forming a receptacle for a bed.

HANAPER *office*, in the court of chancery, is that out of which issue all original writs that pass under the great seal, and all commissions of charitable uses, sewers, bankrupts, idiocy, lunacy, and such like. These writs, relating to the business of the subject, and the returns to them, were originally kept in a hamper, in hanaperio; the other writs, relating to matters wherein the crown is immediately or mediately concerned, were preserved in a little sack or bag, in parva baga; and thence has arisen the distinction of the hanaper office and petty-bag office: both of which belong to the common-law court in chancery.

HAND. See ANATOMY.

HAND *breadth*, a measure of three inches. By this standard the height of horses is estimated.

HAND *cuffs*, an instrument formed of two circular pieces of iron, each fixed on a hinge on the ends of a very short iron bar, which being locked over the wrists of a malefactor prevents his using his hands.

HAND *spikes*, wooden levers used at sea to traverse the ordnance, or to turn the windlass in weighing up the anchor, &c.

HANDS, in heraldry, are borne in coat-armour dexter and sinister, that is, right and left, expanded or open.

HANSE *towns*, port-towns of Germany, of which Lubec and Hamburgh were the chie. They were formerly all of them imperial cities, confederated for their mutual defence, and the protection of their trade.

HARBOUR, a place where ships may ride safe at anchor, chiefly used in speaking of those secured by a boom and chain, and furnished with a mole.

HARDNESS, in physiology, is the resistance opposed by a body to the separation of its particles. This property depends on the force of cohesion, or on that which chemists call affinity, joined to the arrangement of the particles to their figure and other circumstances. A body, says M. Hauy, is considered more hard in proportion as it presents greater resistance to the friction of another hard body, such as a steel file; or as it is more capable of wearing or working into such other body to which it may be applied by friction. Lapidaries judge of the hardness of fine stones, &c. from the difficulty with which they are worn down or polished.

HARE. See LEPUS.

HARIOT, or *heriot*, in law, a due belonging to a lord at the death of his tenant, consisting of the best beast, either horse, ox, or cow, which he had at the time of his death; and in some manors, the best goods, piece of plate, &c. are called hariots. There is both hariot-service, and hariot-custom: when a tenant holds by service to pay a hariot at his decease, which is expressly reserved in the deed of feoffment, this is a hariot service; and where hariots have been customarily paid time out of mind after the death of a tenant for life, this is termed hariot custom.

HARMATTAN, the name given to a singular wind which blows periodically from the interior parts of Africa towards the Atlantic ocean. It prevails in December, January, and February, and is generally accompanied with a fog or haze that conceals the sun for whole days together. Extreme dryness is the characteristic of this wind: no dew falls during its continuance, which is sometimes for a fortnight or more. The whole vegetable creation is withered, and the grass becomes at once like hay. The natives take the opportunity which this wind gives them of clearing the land by setting fire to trees and plants in this their exhausted state. The dryness is so extreme that household furniture is damaged, and the wainscot of the rooms flies to pieces. The human body is also affected by it, so as to cause the skin to peel off, but in other respects it is deemed salutary to the constitution, by stopping the progress of infection, and curing almost all cutaneous diseases.

HARMONICA, or ARMONICA, is a name which Dr. Franklin has given to a musical instrument constructed with drinking-glasses.

This fine instrument was originally composed of a number of glasses of different sizes, fixed on a spindle; the whole was placed in a kind of frame, and made to revolve by a wheel and band after the manner of the spindle of a turning lathe, and the sounds were produced by applying the points of the fingers dipped in water, to the edge of the glasses while revolv-

ing. But this form of the instrument is now become obsolete; the glasses are arranged on a board, in which their base is made fast; they are tuned by partially filling them with water, and the performer by dexterously touching their edges with his wetted fingers, communicates to them a vibratory motion, thus drawing from them a fulness and richness of tone unequalled by any other musical instrument whatever.

HARMONICAL *Arithmetic*, that part of arithmetic which considers musical intervals expressed by numbers, in order to our finding their mutual relations, compositions, and resolutions.

HARMONICAL *Proportion*. See PROPORTION.

HARMONICAL *Series*, a series of many numbers in continual harmonical proportion.

HARMONICAL *sounds*, an appellation given to such sounds as always make a determinate number of vibrations in the time that one of the fundamentals, to which they are referred, makes one vibration.

HARMONICS, that part of music which considered the differences and proportions of sounds, with respect to acute and grave; in contradistinction to rhyme and metre.

HARMONY, in music, the agreeable result or union, of several musical sounds, heard at one and the same time; or the mixture of divers sounds, which together have an effect agreeable to the ear. As a continued succession of musical sounds produces melody, so does a continued combination of these produce harmony.

HARMONY *of the spheres*, or *Celestial Harmony*, a sort of music much talked of by many of the ancient philosophers and fathers, supposed to be produced by the sweetly-tuned motions of the stars and planets. This harmony they attributed to the various proportionate impressions of the heavenly globes upon one another, acting at proper intervals.

HARP, a musical instrument of the string kind, of a triangular figure, held upright between the legs of the person who plays upon it.

HARP, *Eolian*. See ACOUSTICS.

HARPINGS, in a ship, properly denote her breadth at the bow. Some also give the same name to the ends of the bends that are fastened into the stern.

HARPSICHORD, a stringed instrument consisting of a case formed of mahogany or walnut-tree wood, and containing the belly or sounding-board, over which the wires are distended, supported by bridges. But since the invention of that fine instrument, the grand piano-forte, its practice has considerably declined.

HARPOON, an iron spear used to strike the whales in the Greenland and South Sea fisheries. It is furnished with a long shank, and has, at the one end, a broad and flat triangular head, sharpened at both edges: to the other end of this weapon is fastened a long cord which lies carefully coiled in the boat, so as to run out without being entangled.

The gun-harpoon is a weapon used for the same purpose, but is fired out of a gun, instead of being thrown by hand. It is made of steel, and has a chain attached to it, to which the line is fastened.

HARRIER. See CANIS.

HART. See CERVUS.

HAT *Manufactory*. The art of making common hats not involving the description of any complex machinery, or of any very interesting process, we shall content ourselves with the following very general idea of the method generally pursued.

The materials for making hats are rabbits' fur, cut off from the skin, after the hairs have been plucked out, together with wool and beaver. The two former are mixed in various proportions, and of different qualities, according to the value of the article intended to be made; and the latter is used for facing the finer articles. These articles cannot be evenly felted together unless all the fibres be first separated, or put into the same state with regard to each other. This is the object of the process called bowing. The materials are laid upon an open platform of wood or wire, somewhat more than four feet square, called a hurdle, which is fixed against the wall. The workman is provided with a bow or pole of yellow deal-wood, between seven and eight feet long, with two bridges, over which are stretched a catgut, about one-twelfth part of an inch in thickness. The materials being shovelled with a basket towards the right hand end of the hurdle, the workman holding the bow horizontally in his left-hand, lightly places the bow-string, and gives it a pluck with a knobbed stick called the bow-pin. The string in its return, strikes part of the fur, and causes it to rise, and fly partly across the hurdle in a light open form. The quantity bowed at once is called a batt, and never exceeds half that required to make one hat. When the hat is sufficiently bowed, it is ready for hardening. The prepared material being evenly disposed on the hurdle, is covered with a cloth, and pressed successively in its various parts by the hands of the workman. The pressure is gentle, and the hands are very slightly moved backwards and forwards, to favour the entangling of the fibres. In a very short time the stuff acquires sufficient firmness to bear careful handling. The cloth is then taken off, and a sheet of paper, with its corners doubled in, so as to give it a triangular outline, is laid upon the batt, which last is folded over the paper as it lies, and its edges, meeting one over the other, form a conical cap. The joining is soon made good by pressure with the hands on the cloth. Another batt, ready hardened, is then laid on the hurdle, and the cap placed upon it, with the joining downwards. The principal part of the hat is thus put together, and now requires to be worked with the hands a considerable time upon the hurdle, the cloth being occasionally sprinkled with clear water. This is followed by a still more effectual continuation of the felting, called working. This is done in an apparatus called a battery, consisting of a kettle containing water acidulated with sulphuric acid, and eight planks of wood joined together in the form of a frustum of a pyramid, and meeting in the kettle at the middle. The liquor being heated rather higher than unpractised hands could bear, the article is dipped from time to time, and worked on the planks with a roller, and also by folding or rolling it up, and opening it again. The beaver is laid on towards the conclusion of this kind of working. Beer grounds

are used with beaver hats, to render the liquor more tenacious, so that the hat is enabled to hold a greater quantity of it for a longer time.

The next thing to be done is to give it the form required by the wearer. For this purpose, the workman turns up the edge or rim to the depth of about an inch and a half, and then returns the point back again through the centre or axis of the cap, so far as not to take out this fold, but to produce another inner fold of the same depth. The point being returned back again in the same manner produces a third fold; and thus the workman proceeds until the whole has acquired the appearance of a flat circular piece. This is laid upon the plank, where the workman, keeping the piece wet with the liquor, pulls out the point with his fingers, and presses it down with his hand, at the same time, turning it round on its centre in contact with the plank, till he has, by this means rubbed out a flat portion equal to the intended crown of the hat. In the next place he takes a block, to the crown of which he applies the flat central portion of the felt, and by forcing a string down the sides of the block, he causes the next part to assume the figure of the crown, which he continues to wet and work until it has properly disposed itself round the block. The rim now appears like a flounced or puckered appendage round the edge of the crown; but the block being set upright on the plank, the requisite figure is soon given by working, rubbing, and extending this part.

Previous to the dying, the nap of the hat is raised or loosened out with a wire-brush. The dying materials are logwood and a mixture of the sulphates of iron and copper, known in the market by the names of green copperas and blue vitriol.

The dyed hats are taken to the stiffening shop. One workman, assisted by a boy, does this part of the business. He has two vessels or boilers, the one containing the grounds of strong beer, which are applied to the inside of the crown to prevent the glue from coming through to the face. The glue stiffening is applied after the beer-grounds are dried, and then only upon the lower face of the flap, and the inside of the crown. For this purpose the hat is put into another hat, called a stiffening hat, the crown of which is notched, or slit open, in various directions. These are then placed in a hole in a deal board, which supports the flap, and the glue is applied with a brush. The dry hat, after this operation, is very rigid, and its figure irregular. The last dressing is given by the application of moisture and heat, and the use of the brush and a hot iron, somewhat in the shape of that used by tailors, but shorter and broader on the face.

When the rim of the hat is not intended to be of an equal width throughout, it is cut by means of a wooden or metallic pattern. When the hat is completely finished, the crown is tied up in gauze paper, which is neatly ironed down. It is then ready for the subsequent operations of lining, &c.

Hats are also made of chips, straw, or cane, by platting, and sewing the plats together; beginning with the centre of the crown, and working round till the whole is finished. Hats are also wove and made of horse hair, silk, &c. See STRAW HAT.

HATCHEL, or HITCHEL, a tool with which flax and hemp are combed into fine hairs. It consists of long iron pins, or teeth, regularly set in a piece of board.

HATCHES, in a ship, a kind of trap-doors between the main-mast and fore-mast, through which all goods of bulk are let down into the hold.

HATCHES also denote flood-gates set in a river, &c. to stop the current of the water; particularly certain dams or mounds made of rubbish, clay, or earth, to prevent the water that issues from the stream-works and tin-washes in Cornwall, from running into the fresh rivers.

HATCHING, the maturating of fecundated eggs, whether by the incubation and warmth of the parent bird, or by artificial heat, so [illegible] produce young chickens alive.

The art of hatching chickens by me[illegible] of ovens, has long been practised in Egyp[illegible] it is there only known to the inhabitants of a single village named Berme, and to those that live at a small distance from it. Towards the beginning of autumn they scatter themselves all over the country, where each person among them is ready to undertake the management of an oven, each of which is of a different size; but in general they are capable of containing from forty to fourscore thousand eggs. The number of these ovens placed up and down the country is about three hundred and eighty-six, and they usually keep them working for about six months. As, therefore, each brood takes up in an oven, as under a hen, only twenty-one days, it is easy in every one of them to hatch eight different broods of chickens. Every Bermean is under the obligation of delivering to the person who intrusts him with an oven, only two-thirds of as many chickens as there have been eggs put under his care; and he is a gainer by this bargain, as more than two-thirds of the eggs usually produce chickens. In order to make a calculation of the number of chickens yearly so hatched in Egypt, it has been supposed that only two-thirds of the eggs are hatched, and that each brood consists of at least thirty thousand chickens; and thus it would appear that the ovens of Egypt give life yearly to at least ninety-two millions six hundred and forty thousand of these animals.

This operation has of late been effected in this country by the heat afforded by steam; but in artificial hatching, the chickens produced are always very much inferior to those produced in the natural way.

HAUTBOY, a musical instrument of the wind-kind, shaped much like the flute, only that it spreads and widens towards the bottom, and is sounded through a reed.

HAWK. See FALCO.

HAWKERS and *pedlars*, are such dealers or itinerary petty chapmen as travel to different fairs or towns with goods or wares, and are placed under the controul of commissioners, by whom they are licensed for that purpose pursuant to stat. 8 and 9, W. III. c. 25. and 29, Geo. III. c. 26. Traders in linen and woollen manufactories sending their goods to markets and fairs, and selling them by wholesale; manufacturers selling their own manufactures, and makers and sellers of English bone-lace going from house to house, &c. are excepted out of the acts, and not to be taken as hawkers.

HAWKING. See FALCONRY.

HAWSER, in the sea-language, a large

rope, or a kind of small cable, serving for various uses aboard a ship, as to fasten the main and fore shrouds, to warp a ship as she lies at anchor, and wind her up by a capstern, &c.

HAZARD, a game on dice, without tables, is very properly so called, since it speedily makes a man, or undoes him. It is played with only two dice; and as many may play it as can stand round the largest round table.

Two things are chiefly to be observed, viz. main and chance; the latter belonging to the caster, and the former, or main, to the other gamesters. There can be no main thrown above nine, nor under five; so that five, six, seven, eight, and nine, are the only mains flung at hazard. Chances and nicks are from fo[illegible] ten: thus four is a chance to nine, five to [illegible]t, six to seven, seven to six, eight to five; and nine and ten a chance to five, six, seven, and eight: in short, four, five, six, seven, eight, nine, and ten, are chances to any main, if any of these nick it not. Now nicks are either when the chance is the same with the main, as five and five, or the like; or six and twelve, seven and eleven, eight and twelve. Here observe, that twelve is out to nine, seven, and five; eleven is out to nine, eight, six, and five; and ames-ace and deuce-ace are out to all mains whatever.

HAZEL. See Carylus.

HEADBORROW, or Headborough, the chief of the frank pledge, and he that had the principal government of them within his own pledge. He was called also burrowhead, bursholder, third-burrow, tithing-man, chief-pledge, or borrow-elder. He is now occasionally called a constable.

HEAD-*lines*, in a ship, those ropes of all sails which are next to the yard, and by which they are made fast to the yard.

HEALTH, is a right disposition of the body, and of all its parts; consisting in a due temperature, a right confirmation, just connection, and ready and free exercise of the several vital functions.

HEARING. The organ of hearing is the ear, and particularly the auditory nerve and membrane. See Sound.

HEAT. See Caloric.

Heat, *animal.* See Respiration.

Heat, in geography, the diversity of the climates and seasons, arising chiefly from the different angles under which the sun's rays strike upon the surface of the earth. Dr. Halley gives a mathematical computation of the effect of the sun under the different seasons and climates. The different degrees of heat and cold in different places depend in a very great measure upon the accidents of situation, with regard to mountains and valleys, and the soil. The first greatly helps to chill the air by the winds which come over them, and which blow in eddies through the levels beyond; and mountains, sometimes turning a concave side to the sun, have the effects of a burning mirror upon the subject plain; and the like effect is sometimes had from the convex parts of clouds, either by refraction, or reflection. As to soils, a stony, sandy, or chalky earth, it is known, reflects most of the sun's rays into the air again, and retains but few, by which means a considerable accession of heat is derived to the air; as on the contrary, black loose soils absorb most of the rays, and return few into the air, so that the ground is much the hotter.

The following table of the heat of different climates is computed for every tenth degree of latitude, to the equinoctial and tropical sun; by which an estimate may be made of the intermediate degrees.

Lat.	Sun in ♈ ♎.	Sun in ♋	Sun in ♑
0	20000	18341	18341
10	19696	20290	15854
20	18797	21737	13166
30	17321	22651	10124
40	15321	23048	6944
50	12855	22991	3798
60	10000	22773	1075
70	6840	23543	000
80	3473	24673	000
90	0000	25055	000

HEATH. See Erica.

HEDERA, *ivy*, a genus of the monogynia order, in the pentandria class of plants; and in the natural method giving name to the 46th order, hederaceæ. There are five oblong petals, the berry is pentaspermous, girt by the calyx. There are six species with several varieties.

The roots of the ivy are used by leather-cutters to whet their knives upon. Apricots and peaches covered with ivy during the month of February, have been observed to bear fruit plentifully. The leaves have a nauseous taste; Haller says, they are given to children in Germany, as a specific for the atrophy. The common people of England apply them to issues; and an ointment made from them is in great esteem among the Highlanders of Scotland as a ready cure for burns. The berries have a little acidity. In warm climates, a resinous juice exudes from the stalks, which is said to be a powerful resolvent, and an excellent ingredient in plasters and ointments. Horses and sheep eat the plant; goats and cows refuse it.

HEDGES. See Agriculture.

HEDGE-*hog.* See Erinaceus.

HEDYSARUM, a genus of the decandria order, in the diadelphia class of plants; and in the natural method ranking under the 32d order, papilionaceæ. The carina of the corolla is transversely obtuse; the seed-vessel a legumen with monospermous joints. There are ninety species, only one of which is a native of Great Britain; *viz.* H. onobrychis, saintfoin, or cocks-head, and but ten which are natives of Europe. Most of these are perennial. Linnæus relates a remarkable phenomenon belonging to H. gyrans, sensitive hedysarum, which is as follows: This is a wonderful plant, on account of its voluntary motion, which is not occasioned by any touch, irritation, or movement in the air, as in the Mimosa, Oxalis, and Dionæa; nor is it so evanescent as in Amorpha. No sooner had the plants raised from seed acquired their ternate leaves, than they began to be in motion this way and that: this movement did not cease during the whole course of their vegetation, nor were they observant of any time, order, or direction; one leaflet frequently revolved, whilst the other on the same petiole was quiescent; sometimes a few leaflets only

were in motion, then almost all of them would be in movement at once; the whole plant was very seldom agitated, and that only during the first year. It continued to move in the stove during the second year of its growth, and was not at rest even in winter.

Heel, in sea language. If a ship leans on one side, whether she be aground or afloat, she is said to heel a starboard, or a part; or that she heels offwards, or to the shore.

HEGIRA, in chronology, a celebrated epocha among the Mahometans. The event which gave rise to this epocha was the flight of Mahomet from Mecca, with his new proselytes, to avoid the prosecution of the Koraischites: who, being then most powerful in the city, could not bear that Mahomet should abolish idolatry, and establish his new religion. This flight happened in the fourteenth year after Mahomet had commenced prophet: he retired to Medina, which he made the place of his residence.

HEIGHT, in geometry, is a perpendicular let fall from the vertex, or top, of any right-lined figure, upon the base or side subtending it. It is likewise the perpendicular height of any object above the horizon; and is found several ways; by two staffs, a plain mirror with the quadrant, theodolite, or some graduated instrument &c.

HEIR, is he to whom lands, tenements, or hereditaments, by the act of God and right of blood, descend of some estate of inheritance.

Heir-*apparent*. Here we must observe, that no person can be heir until the death of his ancestor; yet in common parlance, he who stands nearest in degree of kindred to the ancestor, is called, even in his life-time, heir apparent. The law also takes notice of an heir apparent, so far as to allow the father to bring an action of trespass for taking away his son and heir, the father being guardian by nature to his son, where any lands descended to him.

Heir-*general*; the heir-general, or heir at common law, is he who after his father's or ancestor's death has a right to, and is introduced into, all his land, tenements, and hereditaments; but he must be of the whole blood, not a bastard, alien, &c. None but the heir-general, according to the course of the common law, can be heir to a warrantry, or sue an appeal of the death of his ancestors.

To prevent the wrong and injury to creditors by the alienation of the lands descended, &c. by 3 and 4 W. & M. c. 14. it is enacted, that in all cases where any heir at law shall be liable to pay the debt of his ancestor, in regard of any lands, tenements, or hereditaments descending to him, and shall sell, alien, and make over, the same before any action brought or process sued out against him, such heir at law shall be answerable for such debt or debts in action or actions of debt to the value of the said land so by him sold, alienated, or made over.

Heir-*looms*, are such goods and personal chattels as, contrary to the nature of chattels shall by special custom to the heir, along with the inheritance.

HEISTERIA, a genus of the monogynia order, in the decandria class of plants, and in the natural method ranking under the 12th order, holoraceæ. There is one species, a tree of Martinico.

HELIACAL, in astronomy, a term applied the rising or setting of the stars, or, more strictly speaking, to their emersion out of and immersion into the rays and superior splendor of the sun.

All the fixed stars in the zodiac, as also the superior planets, Mars, Jupiter, and Saturn, rise heliacally in the morning, a little before sun-rising, and a few days after they have set cosmically. They set heliacally in the evening a short time before their achronical setting But the moon, rises heliacally in the evening, after the new moon, and sets heliacally in the morning, when old and approaching to a conjunction with the sun.

The inferior planets, Venus and Mercury, which sometimes seem to go westward from the sun, and sometimes again have a quicker motion eastward, rise heliacally in the morning, when they are retrograde; but when direct in their motions, they rise heliacally in the [illegible]ing. The heliacal rising or setting of the moon happens when she is 17 degrees distant from the sun; but for the other planets 20° are required: and for the fixed stars more or less according to their magnitude.

HELIANTHUS, *the great sun-flower*, a genus of the polygamia frustanea order, in the syngenesia class of plants, and in the natural method ranking under the 49th order, compositæ. There are 12 species, most of which are now very common in our gardens, though all of them are natives of America.

HELIOCARPUS, a genus of the digynia order, in the dodecandria class of plants, and in the natural method ranking under the 37th order, columniferæ. There is one species, a tree of La Vera Cruz.

HELIOCENTRIC *latitude of a planet*, the inclination of a line drawn between the centre of the sun and the centre of a planet, to the plane of the ecliptic, which may be thus determined.

Heliocentric *place of a planet*, in astronomy, the place of the ecliptic which in the planet would appear to a spectator placed at the centre of the sun.

HELIOMETER, the name of an instrument for measuring with great exactness the diameters of the heavenly bodies, and especially those of the sun and moon. This instrument is a kind of telescope, consisting of two object-glasses of equal focal distance, placed one of them by the side of the other, so that the same eye-glass serves for both. The tube of this instrument is of a conical form, larger at the upper end, which receives the two object-glasses, than at the lower, which is furnished with an eye-glass and micrometer. By the construction of this instrument two distinct images of an object are formed in the focus of the eye-glass, whose distance, depending on that of the two object glasses from one another, may be measured with great accuracy.

HELIX, in geometry. See **Spiral**.

Helix, the *snail*, in zoology, a genus belonging to the order of vermes testacea. The shell consists of one spiral, brittle, and almost diaphanous valve; and the aperture is narrow. Of this genus more than three hundred species have been enumerated. H. formatia, a snail with five spires remarkably ventricose, slightly umbilicated, fasciated with a lighter and deeper brown, is found in the woods of the southern counties of England. It is used in many parts of Europe as food, particularly at Rome during

the weeks of Lent; here they are fattened, and grow to a very large size. H. hortensis, garden snail, has an imperforate shell, globular, pale, with broad interrupted brown bands; this species inhabits the garden and orchard in most parts of Europe; it abounds with a viscid slimy juice, which it readily gives out by boiling in milk and water, so as to render them thick and glutinous, and the compound, especially with milk, is reckoned efficacious in consumptive cases. Snails are very destructive to wall fruit: lime and ashes sprinkled on the ground will keep them away, and destroy the young brood. Fruit, already bitten, should not be taken off the tree, for they will not touch the other, till they have wholly eaten this, if left for them. Eyes of snails are lodged in their horns, one at the end of each horn, which they can retract at pleasure. Cutting off a snail's head, a little stone appears, which is supposed to be a great diuretic, and good in all nephritic disorders. So small an animal as the snail is not free from the plague of supporting other smaller animals; lice being found sometimes on the surface of its body, and worms within its intestines.

HELLEBORUS, *hellebore*, a genus of the polygynia order in the polyandria class of plants, and in the natural method ranking under the 26th order, multisiliquæ. There is no calyx; but five or more petals; the nectaria are bilabiated and tubular; the capsules polyspermous, and a little erect. There are seven species, the most remarkable of which is the niger, commonly called Christmas

HELM, in naval architecture, a long and flat piece of timber, or an assemblage of several pieces, suspended along the hind part of a ship's stern-post, where it turns upon hinges to the right or left, serving to direct the course of the vessel, as the tail of a fish guides the body. The helm is usually composed of three parts, viz. the rudder, the tiller, and the wheel, except in small vessels, where the wheel is unnecessary. The rudder is turned upon its hinges, by means of a long bar of timber called the tiller, which is fixed horizontally in its upper end within the vessel. The movements of the tiller to the right and left, accordingly direct the efforts of the rudder to the government of the ship's course as she advances. The operations of the tiller are guided and assisted by tackle, communicating with the ship's side, called the tiller-rope. In order to facilitate the management of the helm, the tiller rope, in all large vessels, is wound about a wheel which acts upon it with the powers of a crane or windlass.

HELMET, an ancient, defensive armour, worn by horsemen both in war and in tournaments. It covered both the head and face, only leaving an aperture in the front secured by bars, which was called the visor.

It is still used in heraldry by way of crest over the shield or coat of arms, in order to express the different degrees of nobility by the different manner in which it is borne. Thus a helmet in profile is given to gentlemen and esquires: to a knight, the helmet standing forward, and the beaver a little open; the helmet in profile and open, with bars, belongs to all noblemen under the degree of a duke; and the helmet forward and open with many bars, is assigned to kings, princes, and dukes.

HELONIAS, a genus of the trigynia order, in the hexandria class of plants, and in the natural method ranking under the 10th order, coronariæ. There are two species, herbs of America.

HEMIMERIS, a genus of the angiospermia order, in the didynamia class of plants. There are three species, herbaceous plants of the Cape

HEMIONITIS, a genus of the natural order of filices, belonging to the cryptogamia class of plants. The fructifications are in lines, decussating or crossing each other. There are eight species, natives of the West Indies.

HEMIPTERA, derived from ἡμισος *half*, πτερον *wing*, in the Linnæan system, the second order of insects, comprehending twelve genera, viz. the blatta, mantis, gryllus, fulgora, cicada, notonecta, nepa, cimex, aphis, chermes, coccus, and thrips, and a great number of species.

HEMISPHERE, in geometry, the half of a globe or sphere, when it is supposed to be cut through its centre in the plane of one of its great circles. Thus the equator divides the terrestrial globe into the northern and southern hemisphere: in the same manner the meridian divides the globe into the eastern and western hemisphere; and the horizon into two hemispheres, distinguished by the epithets upper and lower.

Hemisphere, is also used to denote a projection of half the terrestrial globe, or half the celestial sphere, on a plane, and frequently called planisphere.

HEMISTICH, in poetry, denotes half a verse or a verse not completed. Of this there are frequent examples in Virgil's *Æneid*; but whether they were left unfinished by design or not, is disputed among the learned.

In reading common English verses, a short pause is required at the end of each hemistich, or half verse.

HEMLOCK. See Cicuta.

HEMP See Cannabis.

HEN. See Phasianus.

HENDECAGON, in geometry, a figure that has eleven sides, and as many angles. In fortification, hendecagon denotes a place defended by eleven bastions.

HEPTAGON, in geometry, a figure of seven sides and seven angles.

HEPTAGONAL *numbers*, in arithmetic, a sort of polygonal numbers, wherein the difference of the terms of the corresponding arithmetical progression is 5. Arithmeticals 1, 6, 11, 16, 21, &c.; and these added together, make heptagonals, 1, 7, 18, 34, 55, &c. One of the properties of these numbers is, that if they be multiplied by 40, and nine be added to the product, the sum will be a square number.

$$\begin{array}{rrcrcr}
\text{Thus} & 1 \times 40 + 9 & = & 49 & = & 7^2 \\
 & 7 \times 40 + 9 & = & 289 & = & 17^2 \\
 & 18 \times 40 + 9 & = & 329 & = & 27^2 \\
 & 34 \times 40 + 9 & = & 1369 & = & 37^2 \\
 & 55 \times 40 + 9 & = & 2209 & = & 47^2 \text{ \&c.}
\end{array}$$

HEPTARCHY, a government of seven persons: also a state or country divided into seven kingdoms, and governed by seven independent princes; in which sense it was particularly applied to the government of South Britain, when divided amongst the Saxons.

HERALD, is an officer at arms, whose business is to denounce war, proclaim peace, or be otherwise employed by the king in martial messages or other business.

Heralds are the judges and examiners of gentlemen's coats of arms, and preservers of

, and they marshal all solemnities nation of princes, and funerals of great persons.

HERALDRY, the science which teaches how to blazon, or explain in proper terms, all that belongs to coats of arms; and how to marshal, or dispose regularly, divers arms on a field.

Arms, or coats of arms, are hereditary marks of honour, made up of fixed and determined colours and figures, granted by sovereign princes, as a reward for military valour, or some signal public service performed. These are intended to denote the descent and alliance of the bearer, or to distinguish states, cities, societies, &c. civil, ecclesiastical, and military.

Men in all ages have made use of figures of living creatures, or symbolical signs, to denote the bravery and courage either of their chief or nation, to render themselves the more terrible to their enemies, and even to distinguish themselves or families as names do individuals.

The Heathen divinities had each their distinctive mark; Jupiter wielded the lightning in his right hand; Neptune bore the three pronged trident; Mars the spear; Saturn the scythe; and Bacchus the spear, encircled by ivy; the Phrygians, the sow; the Goths, a bear; the Thracians, Mars; the ancient French, the lion, which was afterwards changed to the toad, and that again for the fleur-de-lis, sent them from Heaven by an angel, whose commission was directed to Clovis, their first Christian monarch; the Saxons, a horse; the Flemings, a bull; the King of Antioch, an eagle grasping a dragon; the Romans, the eagle; Pompey, a lion holding a sword; yet the Roman people, who were saved by the cackling of geese, despised that bird in too great a degree to admit it into their ensigns; exclusive of the above, there were many nations and individuals who distinguished themselves by exhibiting every description of weapons on their banners. It should also be observed, that the most ferocious beasts and birds were selected as emblematic of honour and courage, for this reason, shields, with their figures only, are considered as most honourable and ancient; but those with trees, flowers, plants, the sun, moon, planets, varieties of colours, or charged with any of the honourable ordinaries, or artificial objects, are deemed of less importance.

The science of heraldry consists principally of blazoning and marshalling; the former is the art of displaying a coat of arms in its proper colours, the latter is the combining various arms in one shield. In blazoning it is usual to begin with the field, and then proceed with the charge, and in naming the objects charged in the field, to mention the most predominant, and next the field, first; and then the most remote. Gwillim observes, that tincture is a variable hue of arms, and as applicable to differences as to the arms, and is distributed into colours and

There are forms in heraldry, which have names only applied to them, and no colour specified in the blazoning; the term sufficiently explaining the colour of each; they resemble a globe or ball, and are called besants the colour or plates argent; hurts, azure; torteauxes, gules; pellets or ogresses, sable; pomeis, vert; golpes, purpure; oranges, tenne, and grosses, sanguine. In these nine varieties are included all the colours generally used in blazonry.

The blazoning of the arms of gentlemen, esquires, knights, and baronets, is derived from metals and colours: those of barons, viscounts, earls, marquisses, and dukes, from precious stones; and those of princes, kings, and emperors from the planets

Or, gold, is expressed by dots (see plate XXI Fig. I;) and is intended as an intimation, that as gold surpasses all other metals in value and purity, he that bears it should endeavour to excel in the same proportion, the same insinuation is implied in the topaz and the sun.

Argent, or white, is represented by a perfect blank (see figure 2), this colour ranks next to Or and without gold and silver Heraldry would be imperfect, argent signifies innocence, temperance, and hope, the pearl was supposed by the ancients to possess a restorative property, and Luna is acknowledged to be the mistress of honour, the seas, and tides.

Gules, red, is expressed by perpendicular line or lines paleways from the chief to the base (see fig. 3 :) this colour has ever been considered as symbolical of majesty and dignity; the ruby cannot be wasted by fire and water; and Mars, the planet, alludes to the heathen God of battle, the pattern of courage and military address.

Azure, blue, the lines in this instance are horizontal (see fig. 4,) and intended for the tint of the air or sky, and is said to denote loyalty, fidelity, and chastity; the precious stone and planet in azure were adopted as possessed of superior qualities, emblematic of the worth of nobles and princes.

Sable, or black, represented by perpendicular and horizontal lines crossing each other at right angles (see fig. 5.) Sable, indicates gravity, constancy, and grief for the loss of friends; the diamond is the most valuable of all stones, and Saturn presides over counsellors and other grave characters.

Vert, green, the lines are bendways (see fig. 6.) or from the sinister corner of the chief to the opposite of the base, and is emblematical of youth, peace, and concord.

Purpure, is a colour composed of a large part of crimson, and a less of blue, and the lines which express it tend directly contrary to those of vert, (see fig. 7.) this word is derived from the fish called purpura; the amethyst was preferred for its excellence to decorate the breast of Aaron, and the planet Mercury signifies goodness of temper.

Tenne, or tawny, is a mixture of red and yellow, and represented by lines like those of purpure, it has been but little used in England, but was formerly in a considerable degree in France.

Sanguine, is composed of a lake and a small quantity of Spanish brown, and expressed by lines as purpure, it was much used by the knights of the Bath, and by the sergeants at law in their vestments; the sardonix is said by St John to be the sixth stone in the Heavenly Jerusalem.

Furs are the next object to be considered, the use of which may be thus explained.

Ermine, implies a field argent, with the powdering sable. See fig. 8.

Ermines, is the reverse, or a field sable, and the powderings argent.

Erminois signifies a field or, and the powdering sable.

Pean, is a field sable, and the powderings or.

Vair, is of two descriptions: if it consists of argent and azure it is sufficient to say vair, but if it is compounded of any other colours, it is usual to say vairy of the colours adopted. See fig. 9.

Fig. 10 is blazoned potent-counter potent, and the colours argent and azure.

Doublings, of furs, were anciently, and are at present used for the linings of the robes and mantles, of senators, consuls, and kings.

The bordure is extended to a great variety, as (fig. 11.) gules a bordure, or; (fig. 12), a bordure indented, argent; (fig. 13) a bordure counter compone, argent and gules.

The bordure is generally one-sixth part of the breadth of the shield, and is ingrailed, indented, charged, componed, and countered. If the inner line of the bordure is strait and the latter plain, the colour of the bordure alone is named in blazoning; if it is charged with parts of plants or flowers, it is described as verdoy of trefoils. If it consists of ermines, vair, or vairy, or any of the furs, the heralds say purflew of ermines. When charged with martlets, charged with an enaluron of martlets.

The label is the first of the distinctive marks of the branches of a family, and is borne by the eldest son during the life of his father (see fig. 14.) The second son bears a crescent, the third a mullet, the fourth a martlet, the fifth an annulet, the sixth a fleur-de-lis, the seventh a rose, the eighth a cross moline, and the ninth a double quatrefoil. See figs. 15, 16, 17, 18, 19, 20, 21, 22.

In the second house, the first son bears a crescent charged with a label during his father's life only; the second son, of the same house, a crescent charged with another crescent; the third, a crescent charged with a mullet; the fourth, a crescent charged with a martlet; the fifth, a crescent charged with an annulet; and the sixth, a crescent charged with a fleur-de-lis.

The mullet, which is the difference of the third house, is thus charged: the first son, with a label during the life of his father; the second with a crescent; the third, with a mullet; the fourth with a martlet; the fifth, with an annulet: and the sixth, a fleur-de-lis.

The martlet, annulet, and fleur-de-lis, the differences of the fourth, fifth, and sixth houses, are charged for distinctions similar to the mullet.

The daughters of families are permitted to bear their father's arms, with the same distinctions used by them.

The shield, or escocheon, the mantle, the helmet, and crest, are the several parts of arms which compose an achievement. Accidents in the escocheon, are points and abatements; the former are places in the shield named according to their position in the middle, or remote, the middle are near the centre. The fess point is the centre of the escocheon. The honour point is in a direct line above it, and the nombril is next below it. Remote points are placed at still greater distances from the fess point, some of which are superior and others inferior; the former occupy the upper part of the escocheon, and of those there are middles and extremes, the middle is the exact middle of the chief between the two extremes; the two superior extreme points occupy the corners of the chief part of the escocheon, and are termed the dexter and sinister. The inferior points are at the base, and of them there are middle and remote, (see fig. 23) in which A is the dexter chief point, B, the precise middle chief; C, the sinister chief; D, the honour point; E, the fess point; F, the nombril point; G, the dexter base; H, the dexter middle base; I, the sinister base point. An abatement is a casual mark annexed to coat armour, which announces some dishonourable act of the bearer. Abatements consist of diminution and reversing, the first is the blemishing of some particular point of the escochoon by sanguine and tenne, which are stains: were the metals used they would be considered additions of honour. See fig. 24.

Augmentations are additional charges borne on an escocheon, a canton, or chief, and given as particular marks of honour. See fig. 26.

Escocheons are either of one or more tinctures; of those of more than one, that is said to be predominant, when some one metal colour or fur is supposed to be spread over the whole surface of the escocheon, which is termed the field, or shield; in such as have more than one tincture, the field and charge must be observed.

The charge is that which possesses the field, whether natural, artificial, vegetable or sensitive, and may be placed throughout the superfices, or in some particular part of the escocheon.

Ordinaries consist of lines variously drawn. The properties of them depend upon their deviations from a right line. Those are termed engrailed, invected, waved, crenelle, or embattled, nebule, indented, and dancette. (See fig. 27.) Of these, and straight lines, honourable ordinaries, abatements, and rewards of honour are composed.

The honourable ordinaries are the cross, chief, fess, barr, pale, chevron, bend, saltier, and escocheon.

The cross occupies the fifth part of the escocheon; if charged, the third; and is borne engrailed, invected, wavey, &c. between a charge, and charged as the rest of the ordinaries are. (See fig. 28.) Argent a cross sable.

The chief is peculiar to those who have obtained it by extraordinary merit: it contains one third part of the escocheon in depth, and is divided into a fillet, which includes a fourth part of the chief, and is placed in the chief point. (See fig. 29.) Or, a chief gules.

The fess is situated in the centre of the shield, and contains in breadth the third part of the escocheon. (See fig. 30. Azure a fess, or.) The bar differs from the fess only as it is but the fifth part of the shield. It is divided into the closet, or a moiety of the bar; and the barrulet, or half the closet.

The pale contains the third part of the escocheon, and is divided into a pallet, or one half of the pale. An endorse is the fourth part of a pale, and is not used but when the pale is between two of them. If the pale is upon an animal, it is usual to say, he is debrused with the pale, if the beast is on the pale, he is supported of the pale. (See fig. 31.) Gules a pale, or.

The chevron resembles the rafters of a house,

and occupies the fifth part of the field, and is divided into the chevronel, which contains half the chevron; and a couple close, the fourth part of the chevron. Those are not borne but in pairs, unless there is a chevron between them. (See fig. 32.) Gules, a chevron argent.

The bend contains the fifth part of the field in breadth when not charged; when charged, the third; and is divided into the bendlet, which is limited to the sixth part of the shield; into a garter, the moiety of a bend; into a cost, the fourth part of a bend; and a riband, the half of a cost. (See fig. 33.) Or, a bend azure.

There is, besides, the bend sinister, which passes obliquely across the escocheon, from the sinister chief to the dexter base. This is divided into the scrape, half the bend; and the battune, the fourth part of the bend, the most common badge of illegitimacy. (See fig. 34.) Gules, a battune argent.

The saltire contains the fifth part of the shield; if charged, the third. This object represents an ancient description of scaling ladder; and, similar to the other ordinaries, is borne engrailed, wavy, &c. &c. (See fig. 35.) Sable, a saltire embattled, counter embattled, argent.

An inescocheon consists of the fifth part of the field, and is to be placed in the fess point. Those who marry an heiress bear her arms on an escocheon of pretence. (See fig. 36.) Ermine, an inescocheon gules.

The pile is an ordinary, in form like a wedge; is an ancient addition to armoury, and adopted from the pointed instrument used to secure foundations on marshy grounds. (See fig. 37.) Azure, a pile ermine.

Partitions are such in which there is no tincture from metal, colour, or fur predominating in them, and are formed of various lines of partition, often causing counter-changing and transmutation. This kind of bearing may be engrailed, &c. (See fig. 38. Plate XXII)Parted per pale, argent and gules.

An example of counterchanges is given in fig. 39. Or, a cross per pale, gules and sable.

Another of ordinaries joined is shewn in fig. 40. Gules on a chevron argent, three bars, gemells sable.

The artificial objects used in heraldry are very numerous, and far too much so for enumeration: they express ensigns of dignity, both spiritual and temporal, the liberal and mechanical professions, and military and naval acts. See fig. 41.

Military figures are equally usual, and consist of castles, battering rams, daggers, spears, &c. &c.

Common charges are composed of objects natural or artificial; celestial are borne single, upon or between any of the honourable ordinaries, and then three are the usual number. (See fig. 42.) Diamond, a fess ermine, between three crescents topaz.

Under the article of vegetables are included trees, plants, leaves, flowers, and fruits. An illustration is given in fig. 43. Vert, five fig-leaves in saltier.

Various parts of the human body and the blood are borne in heraldry., (See fig. 44.) Argent, goutte de sang. These are, however, seldom borne alone, but upon or with some of the ordinaries. Goutte de sang only, always signifies gules; goutte de larmes, drops of tears azure, goutte d'eau, drops of water, argent, de poix, or sable, drops of pitch and d'or. The form of each is the same. The bloody hand is the appropriate mark of a baronet.

Of the various animals used, the lion is the most honourable; and all quadrupeds are considered more so than the bearings of fishes or fowls, particularly the males. The lion is borne rampant, (see fig. 45.) argent, a lion rampant sable; and passant, (see fig. 46.) or, a lion passant sable, in chief three piles of the second. Parts of the lion are also generally adopted. (See fig. 47.) Argent, a lion's head erazed vert. The varieties of beasts and their parts are extremely common, and cannot possibly be specified in an article so brief as the present. (See fig. 48.) Gules, a talbot passant, or, a chief ermine. All animals which are quadrupeds, and oviparous, may be borne. (See fig. 49.) Azure a tortoise erect, or. Fowls of every description are to be represented in the natural acts of standing or flying: those that are either whole footed, or have their feet divided, and have no talons, should be termed membered; the cock, and all birds of prey, must be called armed, and the arming or membering of them is to be of a different colour from the fowl or bird: in the blazoning of fowls which make much use of their wings, if they are not exhibited spread, they must be termed close. The parts and members are generally borne both couped and erazed, and that on or between any of the honourable ordinaries. Birds are considered a more noble bearing than fish. (See fig. 50.) Ermine, an eagle displayed gules.

Fishes are borne in many positions, directly upright, embowed, extended, and indorsed, and surmounting each other, fretted and triangle. (See fig. 51.) Azure, three trouts fretted in triangle argent. Those upright, with fins, were anciently termed in blazoning hauriant, signifying the act of respiration, to accomplish which fish frequently rise to the surface for fresh air; when borne transverse, or swimming, they were called in blazoning naiant. Fishes are borne in part, and on or between any of the honourable ordinaries.

There are, besides, animals or monsters, (See fig. 52.) Argent, a dragon's head erazed vert, holding in his mouth a sinister hand, couped at the wrist, gules.

Such are the peculiarities which distinguish the shield within the boundaries of its surface. We shall now proceed to treat of the helmet, and shew how it is placed in various cases, on the shield, above the coronet, and in others without the latter symbol of rank which equally marks the gradation of title with the helmet. The crown or coronet is more ancient than the helmet, and was invented as a testimony of triumph and victory; the radiated crown was assigned to emperors; but the coronet with pearls on the circle, and foliage intervening, was not used in heraldry more than 300 years past. (See fig. 53—56) the coronet of a Duke, Marquis, Earl, Viscount, and Baron; besides ducal, mural, naval, civic, celestial, custom, valary, &c.

The helmet was worn in battle, and at tournaments, both for use and distinction. Since the invention of fire arms it has been nearly confined to heraldic purposes. The manner of placing them on shields is shewn in figs. 57, 58, 59. Those right in front, many

bars, to sovereigns; those nearly in profile to peers; when front and open, to baronets and knights; in profile close, to esquires and gentlemen.

The wreath is a roll of silk, of two colours blazoned on the shield, and laid on the helmet as a support to the crest. See fig. 60.

The crest is the most elevated part of the armour of the head, and is said to be derived from *crista*, or cocks-comb. The original use appears to have been a protection from the edge of the sword, when aimed at the upper part of the skull. Gwillim asserts, that the crest, or cognizance, should possess the highest place next to the mantle, yet so as to permit the interposition of a scroll, wreath, chapeau, or crown. The knights who celebrated justs wore plumes, of the heron and ostrich feathers, with crests of various materials, which were altered at pleasure. They are of great antiquity, and were of superior honour, as no person was admitted to tilt at a just till he had given proof of his noble descent, and they were limited to those only, (see fig. 61) which exhibits a crest on the wreath.

The mantle is the drapery that is thrown around a coat of arms: it is doubled, or lined throughout by one of the furs.

Supporters are figures by the side of a shield, appearing as if they actually held it erect. (See fig. 62.) In England supporters are confined to peers, and knights of the four orders and proxies of the princes of the blood royal, at installations, except by an especial grant from the Sovereign.

HERALDS. The heralds, which are six in number, are distinguished by the names of Richmond, Lancaster, Chester, Windsor, Somerset, and York, and are all equal in degree, only preceding according to the seniority of their creation.

HERB, in botany, is that part of the plant which rises from the root, and is terminated by the fructification. It comprehends the trunk and stem; the leaves; the fulcra, or supports; and the buds, or, as they are sometimes denominated, the winter quarters of the future vegetable.

HERBACEOUS *plants*, in botany, are those which have succulent stems that die down to the ground every year; those are annual that perish every year; biennial, which subsist by the roots two years; perennial, which are perpetuated by their roots for a series of years.

HERCULES, in astronomy, a constellation of the northern hemisphere.

HEREDITAMENTS, all such things immoveable, whether corporeal or incorporeal, as a man may leave to him and his heirs, by way of inheritance; or which not being otherwise devised, naturally descend to him who is next heir of blood, and not to an executor or administrator, as chattels do. Hereditaments are of two kinds, corporeal and incorporeal. Corporeal hereditaments consist wholly of substantial and permanent objects, all which may be comprehended under the general denomination of land only. Incorporeal hereditaments are not the object of sensation, are creatures of the mind, and exist only in contemplation. They are principally of ten sorts, *viz.* advowsons, tithes, commons, ways, offices, dignities, franchises, presents, and rents.

HERMAPHRODITE, a term formerly applied exclusively to signify a human creature possessed of both sexes. The term is now applied to other animals, and to plants. It is now well known there is no such thing as an hermaphrodite in the human species. In most species of animals, the production of hermaphrodites appears to be the effect of chance; but in the black cattle it seems to be an established principle of their propagation. It is a well known fact, and, as far as has yet been discovered, appears to be universal, that when a cow brings forth two calves, one of them a bull, and the other a cow to appearance, the cow is unfit for propagation, but the bull-calf becomes a very proper bull. They are known not to breed; they do not show the least inclination for the bull, nor does the bull ever take the least notice of them. Among the country people in England, this kind of calf is called a free-martin; and this singularity is just as well known among the farmers as either cow or bull. When they are preserved, it is for the purposes of an ox or spayed heifer; *viz.* to yoke with the oxen, or fatten for the table.

HERMETICAL *seal*, among chemists, a method of stopping glass-vessels, used in chemical operations, so closely, that the most subtile spirit cannot escape through them. It is commonly done by heating the neck of the vessel in a flame, till ready to melt, and then twisting it close together with a pair of pincers.

HERNANDIA, in botany, a genus of the monœcia triandria class and order. Natural order of tricoccæ. Lauri, Jussieu. Ess. char. male, calyx three-parted; corolla three-petaled: female, calyx truncate, quite entire; corolla six-petaled; drupe hollow, with an open mouth, and a moveable nucleus. There are two species. H. sonora, whistling hernandia; and H. ovigera. egg-fruited hernandia.

HERNIARIA, *rupture-wort*, a genus of the pentandria digynia class and order of plants. Natural order of holoraceæ. Amaranthi, Jussieu. Calyx five-parted; corolla none; stamina five, barren, besides the fertile ones; capsule one-seeded. There are four species.

HERON. See Ardea.

HERRING. See Clupea.

HESPERIDÆ, the 19th order in Linnæus's Fragments of a natural method, consisting of five genera, among which are the caryophyllus or clove-tree; and the myrtus, myrtle; allspice or pimento. The plants of this order are of the shrub and tree-kind, and chiefly ever-green.

HESPERIS, *rocket* or *dames' violet*, a genus of the tetradynamia siliquosa class and order of plants. Natural order of siliquosæ. Cruciformes, Tournefort. Cruciferæ, Jussieu. Petals bent obliquely; a gland within the shorter stamens: siliqua stiff; stigma with a forked base, and converging tip; calyx closed. There are seven species.

HETEROGENEOUS, or *heterogeneal*, something that consists of parts of dissimilar kinds, in opposition to homogeneous.

Heterogeneous, in mechanics, such bodies whose density is unequal in different parts of their bulk; or they are such whose gravities in different parts are not proportionable to the bulks thereof.

Heterogeneous *quantities*, are those which are of such different kinds, as that one of them taken any number of times, never equals or exceeds the other.

HETEROSCII. See GEOGRAPHY.

HEUCHERA, in botany, a genus of the pentandria digynia class of plants, the corolla whereof consists of five petals; the fruit is an ovato-accuminated capsule; semibifid, terminating in two reflex points, and containing two cells. There are two species.

HEXACHORD, in ancient music, a concord called by the moderns a sixth.

HEXAEDRON, or *hexahedron*, one of the five regular or Platonic bodies; being indeed the same as the cube; and is so called from its having 6 faces.—The square of the side or edge of a hexahedron, is one third of the square of the diameter of the circumscribing sphere; and hence the diameter of a sphere is to the side of its inscribed hexahedron, as $\surd 3$ to 1.

HEXAGON, in geometry, a figure of six sides and angles; and if these sides and angles be equal it is called a regular hexagon. The side of every regular hexagon, inscribed in a circle, is equal in length to the radius of that circle. Hence, it is easy, by laying off the radius six times upon the circumference, to inscribe an hexagon in a circle. See GEOMETRY.

HEXAGON, in fortification, is a place defended by six bastions.

HEXAGYNIA, in botany, the name of an order of plants, consisting of those which, besides their classical character, have their flowers furnished with six styles.

HEXAMETER, in ancient poetry, a kind of verse consisting of six feet; the first four of which may be indifferently, either spondees or dactyls; the fifth is generally a dactyl, and the sixth always a spondee. Such is the following verse of Horace:

1 2 3 4 5 6
Aut pro|desse vo|lunt, aut|dele|ctare po|etæ.

HEXANDRIA, in botany, a class of plants, the sixth in order, comprehending all those plants which have hermaphrodite flowers, and six stamina in each.

HIBISCUS, *Syrian mallow*, a genus of the polyandria order, in the monadelphia class of plants, and in the natural method ranking under the 37th order, columniferæ. The calyx is double, the exterior one polyphyllous, the capsule quinquelocular and polyspermous. Of this genus there are numerous species.

HIDES, the skins of beasts; but is particularly applied to those of large cattle, as bullocks, cows, buffaloes, horses, &c. Raw or green hide, is that which has not undergone any preparation. There are also hides dried in the hair. Salted hide, is a green hide seasoned with sea salt and alum, or salt-petre, to prevent its corruption. See TANNING and CURRYING.

HIDE *of land*, was such a quantity of land as might be plowed with one plough within the compass of a year, or so much as would maintain a family; some call it 60, some 80 and some 100 acres.

HIERACIUM, *hawkweed*, a genus of the polygamia æqualis order in the syngenesia class of plants, and in the natural method ranking under the 49th order, compositæ. The receptacle is naked, the calyx imbricated and ovate; the pappus simple and sessile. There are 55 species.

HIEROGLYPHICS, in antiquity, mystical characters, or symbols, in use among the Egyptians, and that as well in their writings as inscriptions; being the figures of various animals, the parts of human bodies, and mechanical instruments.

HIEROGLYPHICS, seem to have had their origin in the relation which, by the laws of creation, exists between things natural, or material, spiritual, or moral, and divine.

The meaning of a few of these hieroglyphics has been preserved by ancient writers. Thus we are told they represented the Supreme Deity by a serpent with the head of a hawk. The hawk itself was the hieroglyphic of Osiris; the river-horse, of Typhon; the dog, of Mercury; the cat, of the moon, or Diana; the beetle, of a courageous warrior; a new-born child, of the rising sun; and the like.

HIGHWAY, a public passage for the king's people; whence it is called the king's highway. It seems that anciently there were but four highways in England which were free and common to all the king's subjects, and through which they might pass without any toll, unless there were a particular consideration for it.

There are three kinds of ways, a foot-way, a pack and prime way, which is both a horse and foot way, and a cart way, which contains the other two. A river, common to all men, may also be called the king's highway; and that nuisances in any such ways are punishable by indictment.

If passengers have used, time out of mind, where the roads are bad, to go by outlets on the land adjoining to a highway in an open field, such outlets are parcels of the highway; and, therefore, if they are sown with corn, and the track is foundrous, the king's subjects may go upon the corn.

By the common law, the general charge of repairing all highways lies on the occupiers of the lands in the parish wherein they are. But it is said that the tenants of the lands adjoining are bound to scour their ditches.

Particular persons may be burdened with the general charge of repairing a highway, in two cases; in respect of an inclosure, or by prescription. As where the owner of lands not inclosed, next adjoining to the highway, incloses his lands on both sides thereof. But in all cases, whether a private person be bound to repair a highway by inclosure or prescription, the parish cannot take the advantage of it on the general issue, but must plead it specially.

At common law, it is said that all the country ought to make good the reparations of a highway, where no particular persons are bound to do it; because the whole county have their ease and passage by the said way.

By the ancient common law, villages are to repair their highways, and may be punished for their decay; and, if any do injury to, or straighten the highway, he is punishable in the King's Bench, or before the justices of peace in the court leet, &c Destroying any public turnpike-gate, or the rails or fences thereto belonging, subjects the offender to hard labour for three months, or to transportation for seven years.

Every justice of the peace, by the statute, upon his own view, or on oath made to him by the surveyor, may make presentment of roads being out of repair; and, thereupon, like process shall be issued as upon indictment.

HIGH *water*, the state of the tides when

they have flowed to the greatest height, or rather when they have ceased to flow. At this height the tides remain from 15 to 30 minutes before they begin to ebb again.

HIND, a female stag. See CERVUS.

HINGES, the joints on which gates, doors, lids, folds of tables, &c. hang and turn in opening, shutting, or folding; they are made either of iron or brass, are of different forms and uses, and are named accordingly.

HIP, in the materia medica, the fruit of the dog rose or wild briar.

HIPPIA, a genus of the polygamia necessaria order, in the syngenesia class of plants. There are three species, shrubs of the East Indies and the Cape.

HIPPOBOSCA, a genus of insects of the order diptera. The generic character is, mouth furnished with a bivalve, cylindric, obtuse, nutant snout; body depressed; feet furnished with several claws. This is not an extensive genus; the European hippoboscæ, scarcely affording more than five or six distinct species. Of these the most familiar is the hippobosca equina or horse-fly so troublesome to those animals, as well as to cattle, during the decline of summer, by its irritating motion, and by the pungent pain which its proboscis excites while in the act of suction. In size it varies in different districts, and seems to be largest in the southern climates.

HIPPOPOTAMUS, a genus of quadrupeds of the order of belluæ. The generic character is, the front teeth of the upper jaw are four, and placed in pairs; those of the lower jaw are prominent, and the intermediate ones are protruded forward; the canine teeth are single, and obliquely truncated; the teats are only two, and placed near the groin. It is a native of the warmer regions of the globe, and is chiefly found in the middle parts of Africa, inhabiting large rivers, and especially such as run through countries overshadowed by large forests; walking about at the bottom, and raising itself at intervals to the surface, for the purpose of respiration. By night it quits its watery residence, to graze in the neighbouring plains, devouring great quantities of herbage, destroying the more tender kind of trees and other vegetables. It is sometimes seen even in the sea, at some distance from the mouths of rivers, but this is supposed to be merely for the purpose of exercise; for it will not even drink salt water, and does not prey on fish, or indeed liv on any kind of animal food. The general of the hippopotamus seems to be nearly equal to that of the rhinoceros, and it is sometimes even superior. Its form is highly uncouth; the body being extremely large, fat, and round· the legs very short and thick; the head very large; the mouth extremely wide, and the teeth of vast strength and size, more particularly the tusks or canine teeth of the lower jaw, which are of a curved form: they sometimes measure more than two feet in length, and weigh upwards of six pounds each. The whole animal is covered with short hair, which is much more thinly set on the under parts than on the upper. The hippopotamus when just emerged from the water appears of a palish-brown, or mouse colour, with a blueish or slate coloured cast on the upper parts; and the belly is flesh coloured, the skin appearing through the hair. Its voice is a peculiar kind of interrupted roar, between that of a bull and the braying of an elephant. When on land it moves in a slow and aukward manner; but if pursued, can run with considerable speed, and directly plunging into the water sinks to the bottom and pursues its progress beneath. It is capable, notwithstanding its great bulk, of swimming very swiftly. Sometimes hippopotami are seen going in herds, or companies, to the distance of some miles from the bank of a river in quest of food. If wounded in the water they become furious, and are said to attack the boats or canoes whence the injury proceeded, and either overturn or sink them by biting out large pieces from the bottom. The hippopotamus sleeps in the small reedy islets which are found here and there in the rivers it frequents. In such spots it also brings forth its young; having only one at a birth, which it nurses with great care for a considerable time. The young is capable of being tamed, and we are assured by Belon that he saw one so gentle as to shew no inclination to escape, or to do any kind of mischief when let out of the stable in which it was kept.

These animals are said to be most successfully taken by preparing pitfalls for them, of large size, near the rivers. They are also occasionally shot, or killed with harpoons. Their flesh is reckoned good by the Africans, and the fat is said to be a fine kind of lard. But it is chiefly on account of the teeth, and more particularly of the tusks, that this animal is killed; their hardness being superior to that of ivory, at the same time that they are not so subject to become yellow, for which reason they are much used by the dentists.

HIPPURIS, *mare's tail*, a genus of the monogynia order, in the monandria class of plants, and in the natural method ranking under the 15th order, inundatæ. There are three species, one a native of Britain, and which grows in ditches and stagnant waters.

HIRUDO, the *leech*, a genus of insects belonging to the order of vermes intestina. The body moves either forward or backward. There are 17 species, principally distinguished by their colour. The most remarkable are the following:

1. The *medicinalis*, or medicinal leech, the form of which is well known, grows to the length of two or three inches. The body is of a blackish-brown colour, marked on the back with six yellow spots, and hedged with a yellow line on each side; but both the spots and the lines grow faint, and almost disappear at some seasons. The head is smaller than the tail, which fixes itself very firmly to any thing the creature pleases. It is viviparous, and produces but one young at a time, which is in the month of July. It is an inhabitant of clear running waters, and is well known for its use in bleeding.

2. The *sanguisuga*, or horse-leech, is larger than the former. Its skin is smooth and glossy; the body is depressed, the back is dusky; and the belly is of a yellowish-green, having a yellow lateral margin. It inhabits stagnant waters.

3. The *geometra*, or geometrical leech, grows to an inch and a half in length; and has a smooth and glossy skin of a dusky-brown colour, but in some seasons greenish spotted with white. Its tail is remarkably broad; and it holds as firmly by it as by the head. It is common on stones in shallow running waters

and is often found on trout and other fish after the spawning season.

[illegible]

[illegible] horns, strongly annulated and rugged upon the rings, the tail delated. It inhabits the Atlantic ocean, and is by the fishermen called the sea-leech.

The mouth of the leech is armed with a sharp instrument that makes three wounds at once, and may be compared to the body of the pump, and the tongue or fleshy nipple to the sucker; by the working of this piece of mechanism the blood is made to rise up to the conduit which conveys it to the animal's stomach, which is a membranaceous skin divided into 24 cells.

The leech when fixed should be watched, lest it should find its way into the anus when used for the hemorrhoids, or penetrate into the œsophagus if employed to draw the gums, as it would make great havoc in the stomach or intestines. In such a case, the best and quickest remedy is to swallow some salt; which is the method practised to make it loose its hold when it sucks longer than was intended.

HIRUNDO, in ornithology, a genus of birds of the order of passeres. There are 37 species, chiefly distinguished by their colour. The most remarkable are,

1. The *rustica*, common or chimney swallow, is distinguished from all the other species by the superior forkiness of its tail, and by the red spot on the forehead and under the chin. The crown of the head, the whole upper part of the body, and the coverts of the wings, are black, glossed with a rich purplish blue, most resplendent in the male: the breast and belly white, and in the male tinged with red. The food of this swallow is insects. For the taking of these, nature has admirably contrived their several parts: their mouths are very wide to take in flies, &c. in their quickest motions; their wings are long, and adapted for distant and continual flight; and their tails are forked, to enable them to turn the readier in pursuit of their prey. This species is the first comer of all the British hirundines; and appears in general on or about the 13th of April, though now and then a straggler is seen much earlier. Each species of hirundo drinks as it flies along, sipping the surface of the water; but the swallow alone, in general, washes on the wing, by dropping into a pool for many times together: in very hot weather house-martens and bank-martens dip and wash a little.

2. The *esculenta*, or edible swallow, according to Buffon, is less than the wren, and only two inches and a quarter in length. The bill is black; the upper parts of the body are brown, the under whitish; the tail is forked, and each feather of it is tipped with white; the legs are brown.

The most curious part of the natural history of this bird consists in the nest, which is composed of such materials as render it not only edible, but one of the greatest dainties of the Asiatic epicures.

3. The *urbica*, or marten, is inferior in size to the chimney swallow, and its tail much less forked. The head and upper part of the body, except the rump, are black, glossed with blue; the breast, belly, and rump, are white: the feet are covered with a short white down. This is the second of the swallow kind that appears in our country. They begin to appear about the

[illegible]

[illegible] flights about which they almost obscure by their numbers the face of the sky. Unless these birds are very short-lived indeed, or unless they do not return to the district where they were bred, they must undergo vast devastations somehow, and somewhere; for the birds that return yearly bear no manner of proportion to the birds that retire.

4. The *riparia*, sand-marten, or shore-bird, is 4¾ inches in length, with the whole upper parts of the body of a mouse colour, the throat and under parts white, the bill and legs blackish. It is common about the banks of rivers and sand-pits, where it terebrates a round and regular hole in the sand or earth, which is serpentine, horizontal, and about two feet deep.

5. The *apus*, or swift, is a large species, being near eight inches long, with an extent of wing near 18 inches, though the weight of the bird is only one ounce. Their feet are so small, that the action of walking and rising from the ground is extremely difficult; but nature has made it full amends, by furnishing it with ample means for an easy and continual flight. It rests by clinging against some wall, or other apt body. It breeds under the eaves of houses, in steeples, and other lofty buildings; and makes its nest of grasses and feathers.

The swift is a summer inhabitant of these kingdoms. It comes the latest, and departs the soonest, of any of the tribe.

6. The *melba;* or white bellied swift, is in length eight inches and a half, and weighs two ounces five drams.

7. The *cayennensis*, or white coloured swallow, is about the size of the martin: the head and bill are black; the chin and throat white, passing from the last in a narrow collar round the neck: between the bill and the eye is a streak of white; the rest of the plumage is black, with a gloss of violet.

By the myriads of insects which every single brood of swallows destroys in the course of a summer, they defend us in a great measure from the personal and domestic annoyance of flies and gnats; and, what is of more consequence, they keep down the numbers of our minute enemies, who, either in the grub or winged-state, would otherwise render the labours of the husbandman fruitless.

HISTORY, *civil.* History, in its simplest definition, implies the mere narration of events and facts; but when placed in its true dignity, it is something more than this, it is philosophy "teaching by examples." The study of it is more or less the employment of all persons of reading and education; and the composition of it was the earliest use that was made of letters, since the first poems were historical: it is calculated for the use of all ranks and all professions in life, and places the reader of its events as a spectator out of all hazards, who may reap wisdom from the danger of others, and foretel, to a certain extent, the future by the past.

The general uses of history are exhibited by Dr. Priestley under three heads: 1. He says, history serves to amuse the imagination, and interest the passions in general. 2. It improves the understanding: and 3. It tends to strengthen

the sentiments of virtue. In the first of these views we find history has a great advantage over every work of fiction; for we consider it as the voice of truth. The second has been aptly illustrated by Bolingbroke, who observes, that "He who studies history as he would philosophy, will distinguish and collect certain general principles and rules of life and conduct, which always must be true, because they are conformable to the invariable nature of things; and by doing so he will soon form to himself a general system of ethics and politics on the surest foundations, on the trial of these principles and rules in all ages, and on the confirmation of them by universal experience." And the third is still more evident, from the very light in which characters and events are seen in it. Fame is found just to the dead, however partial to the living.

In regard to what is necessary or useful to be known previous to the study of history, it is proper to observe, that it must be taken in very different degrees of extent, according to the views with which history is read; and these depend very much upon the age and situation of the person who applies to it. But whoever proposes to study history scientifically, must come to the reading of it furnished with the first principles of certain sciences. If not the knowledge, at least a general idea of the principles of human nature, will be an excellent guide to us in judging of the consistency of human characters, and of what is within and what is without the reach of human powers. Philosophical knowledge, in general, will be found of the most extensive use to all persons who would examine with accuracy the achievements of ancient nations in peace or war, or who would thoroughly weigh the accounts of any thing in which the powers of nature are employed. But those sciences which are of the most constant and general use are geography and chronology.

To enumerate all the modern compilations of ancient history which may be serviceable to those who cannot make their searches in the original authors would be endless. That of Rollin must not be passed over. The most complete body of history, however, ancient and modern, is the Universal: which has references to the original writers for almost every paragraph of information. Gillies and Mitford have written Histories of Greece, and Hooke is by far the most preferable among the compilers of the Roman history.

Let it be remembered that in this country, it is an indispensable duty of every man of liberal birth, to be acquainted in a certain degree with the science of politics. History is the school of politics; it unfolds to us the springs of human affairs; the causes of the rise, grandeur, revolutions, and fall of empires. It points out the reciprocal influence of government and of national manners: it dissipates prejudices, nourishes the love of our country, and directs to the best means of improvement. It illustrates equally the blessings of political union and the miseries of faction.

HITCH, in the sea-language, is to catch hold of any thing with a hook or rope, and by this means to hold it fast: thus when a boat is to be hoisted in, the sailors say, hitch the tackles into the ring-bolts of the boat.

HIVE, in country affairs, a convenient receptacle for bees. See Apis.

HOARSENESS. See Medicine.

HODMAN, an appellation given to a young student admitted into Christ's College, Oxford, from Westminster-school.

HOE, a husbandman's tool, somewhat like a cooper's adze to cut up weeds in gardens, fields, &c.

HOEING, in the new husbandry, is the breaking or dividing the soil by tillage while the corn or other plants are growing thereon. It differs from common tillage in the time of performing it; and it is much more beneficial to the crops than any other tillage. This sort of tillage is performed various ways, and by means of different instruments.

HOG. See Sus.

HOGSHEAD, in commerce, a measure of capacity, containing sixty-three gallons.

HOLCUS, Indian millet or corn; a genus of the monœcia order, in the polygamia class of plants; and in the natural method ranking under the 4th order, gramina. The male calyx is a bivalved glume; there is no corolla, but three stamina. Of this genus there are fifteen species, two of which are natives of Britain.

HOLD, that part of a ship which lies between the keelson and the lower deck; in which, divided by bulk heads, are the steward's room, powder-room, bread-room, and the boat-swain's and carpenter's store-rooms. In a merchantman, all the goods and lading in general, are stowed in the hold.

HOLLAND, in commerce, a fine and close kind of linen, so called from its being first manufactured in Holland.

HOLLY. See Ilex.

HOLOCENTRUS. Holocentrus, a genus of the order thoracici; the generic character is, habit of the genus perca; gill-covers scaly, serrated, and aculeated; scales in most species, hard and rough. There are about thirty-five species.

HOLOSTEUM, a genus of the trigynia order, in the triandria class of plants, and in the natural method ranking under the 22d order, caryophyllei. The calyx is pentaphyllous; the petals five; the capsule unilocular, and nearly cylindrical, opening at top. There are five species.

HOMALIUM, a genus of the class and order polyandria trigynia. The calyx is six or seven-parted: corolla six or seven-petalled: stamina, 21 in three bodies: pericarpium, one-celled, many-seeded: there are two species, a tree of Jamaica, and a shrub of Guiana.

HOMICIDE, properly so called, is the killing of a man by a man. Of this there are several species, as homicide by self-defence, homicide by misadventure, justifiable homicide, manslaughter, chance-medley, and murder.

Homicide by self-defence. Homicide se defendendo, or in a man's own defence, seems to be, where one has no other possible means of preserving his life from one who combats with him on a sudden quarrel, and kills the person by whom he is reduced to such inevitable necessity.

Homicide by misadventure, is where a man in doing a lawful act without any intent of hurt, unfortunately chances to kill another, as where a labourer being at work with a hatchet, the

head thereof flies off, and kills one who stands by

It seems clear, that neither homicide by misadventure, nor homicide se defendendo are felonious, because they are not accompanied with a felonious intent, which is necessary in every felony.

Justifiable homicide. To make homicide justifiable, it must be owing to some unavoidable necessity, to which a person who kills another must be reduced, without any manner of fault in himself.

Justifiable homicide of a public nature is such as is occasioned by the due execution or advancement of public justice.

Manslaughter. Homicide against the life of another, is either with or without malice; that which is without malice is called manslaughter, or sometimes chance medley, by which is understood such killing as happens on a sudden quarrel.

The only difference between murder and manslaughter is, that murder is upon malice aforethought, and manslaughter upon a sudden occasion, as if two meet together, and striving for the wall the one kills the other, this is manslaughter and felony.

Chance or chance-medley. Authors of the first authority disagree about the application of this word; by some it is applied to homicide by misadventure, by others to manslaughter.

Murder is the highest crime against the law of nature, that a man is capable of committing. It is when a man of sound memory, and at the age of discretion, unlawfully kills another person under the King's peace with malice aforethought, either expressed by the party, or implied by the law, so as the party wounded or hurt, die of the wound or hurt within a year and a day, the whole day on which the hurt was done, being reckoned the first.

The law so far abhors all duelling in cold blood, that not only the principal who actually kills the other, but also his seconds are guilty of murder, whether they fought or not; and it is holden that the seconds of the person killed, are also equally guilty, in respect to the countenance which they give to their principals in the execution of their purpose, by accompanying them therein, and being ready to bear a part with them.

HOMOGENEOUS, or *homegeneal*, an appellation given to things, the parts of which are similar or of the same nature and properties.

Homogeneous *light*, that whose rays are all of one colour and degree of refrangibility, without any mixture of others. See the article Colour.

Homogeneous *surds*, those which have the same radical character, or signs, as $\sqrt[2]{a}$, and $\sqrt[2]{b}$. See the article Surd.

HOMOLOGOUS, in geometry, an appellation given to the corresponding sides and angles of similar figures, as being proportional to each other.

All similar figures have their like sides homologous, or proportional to one another: their areas also are homologous, or proportional to the squares of the like sides, and their solid contents are homologous or proportional to the cubes of the same.

HONE, a fine kind of whetstone, used for setting razors, pen-knives, and the like.

HONEY is a vegetable product very similar in its properties to sugar. It is found in large quantities in a number of vegetables, is collected by the bee, and fed upon by many insects. It is always formed in the flower, chiefly at the base of the pistil. Honey differs much in colour and in consistence: it contains much saccharine matter, and probably some mucilage, from which it derives its softness and viscosity. Honey yields a strong liquor called *Mead.* There are two species of honey; the one is yellow, transparent, and of the consistence of turpentine; the other white, and capable of assuming a solid form. These two species are often united. In France, a good swarm of bees, in two years, will yield nearly thirty pounds of honey; and they are still more profitable in countries that are covered with flowers the greater part of the year. The white or virgin honey trickles out spontaneously from the combs. These they break soon after they are made, and lay them upon hurdles or mats of osier, or on linen cloth, and an excellent white honey will fall from the combs, and grow hard in a short time. Afterward they put them into glazed earthen pots. Honey produced in mountainous countries is more highly flavoured than that in low grounds. The honey made in the spring is more esteemed than what is gathered in the summer; that of the summer more than that of the autumn. There is also a preference given to that of young swarms. Honey is the production of most countries; yet more abundant in the island of Candia, and in the greater part of the islands of the Archipelago, than any where else. The Sicilian honey seems to be particularly high flavoured. Considerable quantities of honey are produced by the wild bees in the woods of North America. See Apis.

HONOUR signifies a testimony of esteem or submission, expressed by words, actions, and exterior behaviour, by which we make known the veneration and respect we entertain for any one on account of his dignity or merit. The word is also used for the esteem due to virtue, glory, and reputation. It is also used for *virtue* and *probity* themselves, and for an exactness in performing whatever we have promised, in which last sense we use the term *a man of honour.* But honour is more particularly applied to the two different kinds of virtue; bravery in men, and chastity in women.

HONOUR, in law, is used especially for the more noble sort of seigniories on which other inferior lordships or manors depend, by performance of some customs or services to those who are lords of them.

Honour, *courts of.* There is a court of honour of earl marshal of England, &c. which determines disputes concerning precedency and points of honour.

Honours, *military;* all armies salute crowned heads in the most respectful manner, colours and standards dropping, and officers saluting. Different ranks of officers are saluted in a different mode.

Honours *of war*, are stipulated terms which are granted to a vanquished enemy, and by which he is permitted to march out of a town, from a camp, or line of entrenchments, with all the insignia of military etiquette.

HOP. See Humulus.

HOPEA, a genus of the polyandria order, in

the polyadelphia class of plants. There is only one species, the tinctoria, a native of Carolina.

HORARY *circle*. See GLOBE.

HORARY *motion of the earth*, the arch it describes in the space of an hour, which is nearly 15 degrees, though not accurately so, as the earth moves with different velocities, according to its greater or lesser distance from the sun.

HORD, in geography, a company of wandering people, which have no settled habitation, but stroll about, dwelling in waggons or under tents, to be ready to shift as soon as the herbage, fruit, and the present province is eaten bare; such are several tribes of the Tartars, particularly those who inhabit beyond the Wolga, in the kingdoms of Astracan and Bulgaria.

HORDEUM, *barley*, a genus of the triandria-trigynia class of plants, the corolla whereof consists of two valves; the inferior valve is angular, of an ovato-acuminated figure, bellied, and longer than the cup, and terminates in a very long arista; the anterior valve is lanceolated, plane, and smaller: the corolla serves as a pericarpium, surrounding the seed, and not letting it out; the seed is oblong, ventricose, pointed at each end, and marked with a longitudinal furrow.

HORIZON. See ASTRONOMY and GEOGRAPHY.

HORIZONTAL *dial*. See DIALLING.

HORIZONTAL *line*. See PERSPECTIVE.

HORIZONTAL *plane*, that which is parallel to the horizon of the place, or nothing inclined thereto. The business of levelling is to find whether two points are in the horizontal plane, or how much the deviation is.

HORIZONTAL RANGE *of a piece of ordnance*, is the distance at which it falls on or strikes the horizon, or on a horizontal plane, whatever is the angle of elevation or direction of the piece. See GUNNERY.

HORN. An animal substance, chiefly membranous, composed of coagulated albumen, with a little gelatin, and about half a per cent of phosphate of lime. But the horns of the buck and hart are of a different nature, being intermediate between bone and horn.

HORN is also a musical instrument of the wind kind, chiefly used in hunting, to animate the hunters and the dogs, and to call the latter together. The French horn is bent into a circle, and goes two or three times round, growing gradually larger and wider towards the end, which in some horns is nine or ten inches over.

HORNS *of insects*, the slender oblong bodies projected from the heads of those animals, and otherwise called antennæ or feelers.

HORN *ore*, in mineralogy, is one of the species of silver ore; its most frequent colour is pearl-grey, of all degrees of intensity, which borders sometimes on milk-white, and sometimes approaches to lavender and violet-blue. It passes also, though but rarely, into green. It is found massive, disseminated in thick membranes, in roundish hollow balls; also crystallized: specific gravity 4.8. When heated on charcoal before the blow-pipe, it melts quickly, and leaves a globule of silver; it is even fusible by the flame of a candle; it takes a polish by friction; and its constituent parts, according to Klaproth, are

Silver	67.75
Muriatic acid	21.
Sulphuric acid	0.25
Oxide of iron	6.0
Alumina	1.75
Lime	0.25
	97.00
Loss	3.00
	100.00

It occurs in veins, and generally in their upper parts, and is usually accompanied with brown iron ochre, and with silver glance, but seldom with native silver and red silver ore.

HORN *stone*, or HORN *steen*, in mineralogy, a species of the flint genus, divided by Werner into three sub-species: the splintery, the conchoidal, and the wood-stone. The most common colour of the splintery horn-stone is grey; it is found in veins, in the shape of balls, in lime-stone, and forming the basis of porphyry, in several parts of Germany, and also in the Shetland islands. It appears to differ from quartz in containing a greater proportion of alumina; when it contains a very large quantity, it passes into jasper. It sometimes borders on chalcedony and flint. The best mill-stone, called French bur, is cellular-splinter hornstone. Conchoidal hornstone occurs in beds, accompanied with agate, and is distinguished from the splintery by the lightness of its colours, its fracture, and its inferior translucency and hardness.

In the wood-stone several colours occur together, and it commonly exhibits coloured delineations, as clouded and striped, and these arrange themselves in the direction of the original woody texture.

HORNBLENDE. A sub-species of straight-edged augite. There are three varieties of hornblende: the common, hornblende-slate, and basaltic hornblende.

1. *Common hornblende*. Colour, greenish-black, and black of other shades. Massive disseminated and crystallized, in a broad, thin, very oblique, four-sided prism, and in a six-sided prism. The lateral planes of the prism are deeply longitudinally streaked. Lustre shining, pearly. Cleavage twofold and oblique angular. Fracture uneven. The black hornblende is opaque, the green translucent on the edges. Harder than apatite, but not so hard as felspar. Mountain-green streak. When breathed on, it yields a peculiar smell. Difficultly frangible. Sp. gr. 3.25. It melts before the blowpipe, with violent ebullition, into a greyish-black coloured glass. Its constituents are, 42 silica, 12 alumina, 11 lime, 2.25 magnesia, 30 oxide of iron, 0.25 ferruginous manganese, and 0.75 water, with a trace of potash. It is an essential ingredient of the mountain rocks, syenite, and greenstone, and it occurs frequently in granite, gneiss, &c. It is found abundantly in the British Islands, and on the Continent.

2. *Hornblende-slate*. Colour intermediate between greenish-black, and blackish-green. Massive. Lustre glistening, or pearly. Fracture straight slaty. Fragments tabular. Opaque. Streak greenish. Semi-hard Difficultly fran-

gible. It occurs in beds in gneiss, in Aberdeenshire, Banffshire, and Argyllshire, in many parts of England and Ireland, and abundantly on the Continent.

3. *Basaltic hornblende.* Colour, velvet-black, or brownish-black. It occurs crystallized, in the following figures: an unequiangular six-sided prism; and the six-sided prism both variously acuminated. Lustre of the cleavage, which is double, is splendent, approaching to pearly. Fracture small grained uneven. Opaque. Rather harder than common hornblende, and more easily frangible. Streak dark greyish-white. Sp. gr. 3.16. It fuses into a black glass. Its constituents are, 47 silica, 26 alumina, 8 lime, 2 magnesia, 15 oxide of iron, and 0.5 water. It occurs imbedded in basalt, along with olivine and augite at Arthur's Seat, near Edinburgh, in Fifeshire, and the Islands of Mull, Canna, Eigg, and Skye.

HORNET. See Vespa.

HOROLOGY. For a description of the article of clock-work the reader has been referred to *horology*, under which it was our intention to treat of it; but for the sake of more effectually equalizing the alphabetical arrangement of the work we have resolved to introduce it under the article Watchwork, which See.

HORSE. See Equus.

Horse-*dealers*. Every person exercising the trade or business of a horse-dealer, must take out a licence from the stamp-office. Horse-dealers who shall carry on the said business without having obtained a licence under this act, shall be liable to be assessed the duties on riding-horses, and shall deliver lists thereof as other persons.

HORSES. It shall be lawful for any person, native or foreigner, at any time to ship, lade, and transport by way of merchandize, horses into any parts beyond the seas in amity with his majesty, paying for each horse, mare, or gelding, 5*s*. and no more.

No person convicted of feloniously stealing a horse, gelding, or mare, shall have the privilege of clergy. 1. Edw. VI. c. 12. And not only all accessaries before such felony done, but also all accessaries after such felony, shall be deprived and put from all benefit of their clergy, as the principal, by statute heretofore made, is or ought to be.

If a horse be stolen out of the stable, or other curtilage of a dwelling-house, in the night time, it falls under the denomination of burglary; if in the day-time, it falls under the denomination of larceny from the house. Where any person shall in the night-time maliciously, unlawfully and willingly kill or destroy any horses, sheep, or other cattle, of any person, every such offence shall be adjudged felony, and the offender shall suffer as in the case of felony.

If a man rides to an inn, where his horse has eaten, the host may detain the horse till he is satisfied for the eating, and without making any demand.

HORTUS *ciccus*, a *dry garden*, an appellation given to a collection of specimens of plants, carefully dried and preserved. The value of such a collection is very evident, since a thousand minutiæ may be preserved in the well-dried specimens of plants, which the most accurate engraver would have omitted.

Among the different methods adopted by botanists for obtaining a hortus ciccus, the following appear to be the most practicable:—Plants may be dried by pressing in a box of sand, or with a hot smoothing iron. Each of these has its advantages. If pressure be employed, a botanical press may be procured. The press is made of two smooth boards of hard wood, eighteen inches long, twelve broad, and two thick. Screws must be fixed to each corner with nuts. If a press cannot easily be had, books may be employed. Next some quires of unsized blotting paper must be provided. The specimens, when taken out of the tin box, must be carefully spread on a piece of pasteboard, covered with a single sheet of the paper quite dry; then place three or four sheets of the same paper above the plant, to imbibe the moisture as it is pressed out; it is then to be put into the press. As many plants as the press will hold may be piled up in this manner. At first they ought to be pressed gently. After being pressed for twenty-four hours or so, the plants ought to be examined, that any leaves or petals which have been folded may be spread out, and dry sheets of paper laid over them. They may now be replaced in the press, and a greater degree of pressure applied. The press ought to stand near a fire, or in the sunshine. After remaining two days in this situation, they should be again examined, and dry sheets of paper be laid over them. The pressure then ought to be considerably increased. After remaining three days longer in the press, the plants may be taken out, and such as are sufficiently dry may be put in a dry sheet of writing-paper. Those plants which are succulent may require more pressure, and the blossom paper again renewed. Plants which dry very quickly, ought to be pressed with considerable force when first put into the press; and if delicate, the blossom-paper should be changed every day. When the stem is woody, it may be thinned with a knife, and if the flower be thick or globular as the thistle, one side of it may be cut away; as all that is necessary, in a specimen, is to preserve the character of the class, order, genus, and species. Plants may be dried in a box of sand in a more expeditious manner, and this method preserves the colour of some plants better. The specimens, after being pressed for ten or twelve hours, must be laid within a sheet of blossom-paper. The box must contain an inch deep of fine dry sand, on which the sheet is to be placed, and then covered with sand an inch thick; another sheet may then be deposited in the same manner, and so on, till the box be full. The box must be placed near a fire for two or three days. Then the sand must be carefully removed, and the plants examined. If not sufficiently dried, they may again be replaced in the same manner for a day or two. In drying plants with a hot smoothing iron, they must be placed within several sheets of blotting paper, and ironed till they become sufficiently dry. This method answers best for drying succulent and mucilaginous plants. When properly dried, the specimens should be placed in sheets of writing-paper, and may be slightly fastened by making the top and bottom of the stalk pass through a slip of the paper, cut nearly for the purpose. Then the name of the genus and species should be written down, the place where it was found, nature of the soil, and the season of the year.

HOT-*beds*, in gardening, beds made with

fresh horse-dung, or tanners bark, and covered with glasses to defend them from cold winds. According to the quantity and quality of the materials put together for hot-beds, the heat will be proportioned as to strength and duration. The place where hot-beds are worked should be open to the full sun, catching it as early as possible in the morning, and having it as long as can be in the evening; and if not naturally sheltered, it should be screened from the north and north-east winds by a boarded fence or rather one of reeds, as from a solid fence the wind reverberates. Working of the dung is necessary previous to the making of a hot-bed, *i. e.* it should be thrown together on a heap, in a conical form; and when it has taken a thorough heat, and has been smoaking for two or three days, it should be turned over, moving the outside in, or mixing the colder parts with the hot. When it has taken heat again for two or three days, give it a second turn as before, and having lain the same time, it will be in proper order for making a good lasting bed with a steady heat.

HOT-*house,* in gardening, an erection for the culture of the tender exotics of tropical climates. It is generally built lower than a green-house, with double flues, and a pit in the middle for tanners' bark, in which, as in a kind of hot-bed, the pots containing the plants are to be set. A south-west aspect is found to be the most suitable for an erection of this kind, as by an economical use of the sun's rays, much of the expense of heating may be saved.

HOVERING. Ships of 50 tons, laden with customable or prohibited goods, hovering on the coasts of this kingdom, within the limits of any port (and not proceeding from foreign parts,) may be entered by officers of the customs, who are to take an account of the lading, and to demand and take a security from the master, by his bond to his majesty, in such sum of money as shall be treble the value of such foreign goods then on board; that such ship shall proceed, as soon as wind and weather, and the condition of the ship will permit, on her voyage to foreign parts.

HOUND. See CANIS.

HOUR, *hora,* in chronology, an aliquot part of a natural day, usually a 24th, sometimes a 12th. See ASTRONOMY, GEOGRAPHY, &c.

There are different hours used by chronologers, astronomers, dialists, &c. Sometimes hours are divided into equal and unequal. Equal hours are the 24th part of a day and night precisely, that is, the time wherein 15 degrees of the equator mount above the horizon. These are also called equinoctial hours, because they are measured on the equinoctial; and astronomical, because used by astronomers. They are also differently denominated according to the manner of accounting them in different countries. Astronomical hours are equal hours, reckoned from noon or mid-day, in a continued series of twenty-four. Babylonish hours are equal hours reckoned in the same manner from sun-rise. The Italian hours are also equal hours, reckoned in the same manner too, from the sun-setting. European hours are also equal hours, reckoned from midnight; 12 from thence to noon, and 12 more from noon to midnight. Jewish, or planetary, or ancient hours, are the twelfth part of the artificial day and night, each being divided into 12 equal parts. Hence, as it is only in the time of the equinoxes that the artificial day is equal to the night, it is then only that the hours of the day are equal to those of the night. At other times they will be always either increasing or decreasing: and they will be the more or less unequal according to the obliquity of the sphere.

HOUR *glass,* a popular kind of chronometer, which serves to measure the flux of time by the running of sand from one vessel into another. Glasses of this kind for half and quarter hours, and for less divisions of time are much used at [illegible]

HOUSE, in astrology, denotes the twelfth part of the heavens. The division of the heavens into houses, is founded upon the pretended influence of the stars, when meeting in them, on all sublunary bodies. These influences are supposed to be good or bad, and to each of these houses particular virtues are assigned, on which astrologers prepare and form a judgment of their horoscopes.

HOUSE, a habitation, or place built with conveniences for dwelling in. See ARCHITECTURE.

The word is also used to designate a noble family, or a race of illustrious persons descended from the same stock. Thus we say, the house or family of the Stuarts, the Bourbons, the house of Hanover, &c

HOUSEHOLD, the whole of a family considered collectively, including the mistress, children, and servants; but the household of a sovereign prince includes only the officers and domestics belonging to his palace.

The principal officers of his majesty's household are, the lord steward, lord chamberlain of the household, the groom of the stole, the master of the great wardrobe, and the master of the horse.

HUDSONIA, a genus of the monogynia order, in the dodecandria class of plants. There is no corolla; the calyx is pentaphyllous and tubular; there are 15 stamina; the capsule is unilocular, trivalvular, and trispermous. These is one species, a shrub of Virginia.

HUE AND CRY, is the ancient common law process after felons, and such as have dangerously wounded any person, or assaulted any one with intent to rob him; and it has received great countenance and authority by several acts of parliament. For the levying of hue and cry, although it is a good course to have a justice's warrant, where time will permit, in order to prevent causeless hue and cry; yet it is not necessary nor always convenient, for the felon may escape before the warrant is obtained.

HUER, a name given to certain fountains in Iceland, of a most extraordinary nature, forming at times jets d'eaux of scalding water 94 feet high and 30 in diameter. They arise out of cylindrical tubes of unknown depths. Near the surface they expand into apertures of a funnel shape, and the mouths spread into a large extent of stalactical matter, formed of successive scaly concentric undulations. The playing of these stupendous spouts is foretold by noises roaring like the cataract of Niagara

HUGONIA, a genus of the decandria order in the monadelphia class of plants, and in the natural method ranking with those of which the order is doubtful. There is one species, a tree of the East Indies.

HUGUENOTS, a name given by way of contempt to the protestants of France, in the year 1560; but authors are not agreed as to its origin. The most plausible opinion, however, is that of Pasquier, who observes, that at Tours, the place where they were first thus denominated, the people had a notion that an apparition or hobgoblin, called king Hugon, strolled about the streets in the night-time; whence as those of the reformed religion met chiefly in the night to pray, &c. they called them Huguenots, that is, the disciples of king Hugon.

HULL, in the sea-language, is the main body of a ship, without either masts, yards, sails, or rigging.

HUMMING-*bird*. See TROCHILUS.

HUMULUS, the *hop*, a genus of the pentandria order, in the diœcia class of plants, and in the natural method ranking under the 53d order, scabridæ. The male calyx is pentaphyllous; there is no corolla; the female calyx is monophyllous, patent obliquely, and entire; there is no corolla, but two styles, and one seed within the calyx, the latter consisting of one large leaf. There is only one species, viz. The lupulus, which is sometimes found wild in hedges near houses and gardens, but probably not indigenous. The stalk is weak and climbing; it creeps up the support in a spiral, ascending always from the right hand to the left.

Hops are said to have been first brought into England from the Netherlands in the year 1524. The richest and strongest ground is the most proper for the hop; and if it is rocky within two or three feet of the surface, the hops will prosper well; but they will by no means thrive on a stiff clay or spongy wet land. Hops require to be planted in a situation so open that the air may freely pass round and between them. The hills should be eight or nine feet asunder. Persons ought to be very curious in the choice of plants. The two best sorts are the white and the grey bind; the latter is a large square hop, more hardy, and is the more plentiful bearer, and ripens later than the former. There is another sort of the white bind, which ripens a week or ten days before the common; but this is more tender and a less plentiful bearer, but it has this advantage, that it comes first to market. If there is a sort of hop you value, and would increase plants and sets from, the superfluous binds may be laid down when the hops are tied, cutting off the tops, and burying them in the hils; or when the hops are dressed, all the cuttings may be saved, for almost every part will grow and become a good set the next spring. Five good sets should be planted in every hill, one in the middle, and the rest round about sloping. Let them be pressed close with the hand, and covered with fine earth, and the stick should be placed on each side the hill to secure it. About the middle of March they ought to be dressed in dry weather, having with an iron picker cleared away all the earth out of the hills, with a sharp knife cut off all the shoots which grow up with the binds the last year; and also all the young suckers, that none be left to sun in the alley, and weaken the hill, to cut one part of the stock lower than the other, making that part low that was left highest the preceding year In dressing hops that have been planted the year before, cut off both the dead tops and the young suckers which have sprung up from the sets, and also to cover the stocks with fine earth, a finger's length in thickness. About the middle of April the hops are to be poled. Two or three binds are enough for a pole and all the sprouts that you have no occasion for are to be plucked up. About the beginning of July the hops begin to blow, and will be ready to gather about the latter end of August. A judgment may be made of their ripeness by their strong scent, their hardness, and the brownish colour of their seed. When by these tokens they appear to be ripe, they must be picked with all the expedition possible. The best method of drying hops is with charcoal on an oast or kiln, covered with hair cloth, of the same form and fashion that is used for drying malt. It may be known when they are well dried by the brittleness of the stalks, and the easy falling off of the top leaves. As soon as the hops are taken off the kiln, lay them in a room for three weeks or a month to cool, and then bag them; the harder they are trodden, the better they will keep.

HURDLES, in fortification, twigs of willows or osiers interwoven close together, sustained by long stakes, and usually laden with earth.

HURDLES, in husbandry, certain frames, made either of split timber, or of hazel-rods wattled together, to serve for gates in inclosures, or to make sheepfolds, &c

HURRICANE, a furious storm of wind, owing to a contrariety of winds. Hurricanes are frequent in the West Indies, where they make terrible ravages, by rooting up trees, destroying houses, shipping, and the like. The natives, it is said, can foretel hurricanes by the following prognostics: 1. All hurricanes happen either on the day of the full, change, or quarter of the moon. 2. From the unusual redness of the sun, the great stillness, and at the same time, turbulence of the skies, swelling of the sea, and the like, happening at the change of the moon, they conclude there will be a hurricane next full-moon, and if the same signs be observed on the full-moon, they may expect one next new moon. As to the cause of hurricanes, they undoubtedly arise from the violent struggle of two opposite winds. Now as the wind betwixt the tropics is generally easterly, and upon the sun's going back from the northern tropic, the western winds pour down with violence upon those parts, the opposition of these contrary winds cannot fail to produce a hurricane. Hurricanes shift not through all the points of the compass, but begin always with a north wind, veer to the east, and then cease; and their shifting between these two points is so sudden and violent, that it is impossible for any ship to veer with it; whence it happens that the sails are carried away, yards and all, and sometimes the masts themselves wreathed round like an osier.

HUSBAND and *wife*, usually called baron and feme, are one person in law: that is, the very being or legal existence of the woman is suspended during the marriage, or at least is incorporated and consolidated into that of the husband, under whose protection and cover she performs every thing. She is therefore called in our law a *feme covert*, that is, under the protection and influence of her husband, her baron, or lord; and her condition during her marriage is called her coverture.

A man cannot grant lands to his wife during her coverture, nor any estate or interest to her, nor enter into covenant with her. But he may by his deed covenant with others for her use, as for her jointure, or the like; and he may give to her by devise or will, because the devise or will does not take effect till after his death.

All deeds executed by the wife, and acts done by her during her coverture, are void, except a fine, or the like matter of record, in which case she must be solely and secretly examined, that it may be known whether or no her act is voluntary.

A wife is so much favoured in respect of that power and authority which her husband has over her, that she shall not suffer any punishment for committing a bare theft in company with, or by coercion of her husband. But if she commits a theft of her own voluntary act, or by the bare command of her husband, or is guilty of treason, murder, or robbery, in company with or by coercion of her husband, she is punishable as much is if she was sole; because of the odiousness and dangerous consequences of these crimes.

By marriage the husband has power over his wife's person; and the courts of law still permit a husband to restrain a wife of her liberty, in case of any gross misbehaviour. But if he threatens to kill her, &c. she may make him find surety of the peace, by suing a writ of supplicavit out of chancery, or by preferring articles of the peace against him in the court of king's bench, or she may apply to the spiritual court for a divorce propter sævitatem.

The husband by marriage obtains a freehold in right of his wife, if he takes a woman to wife that is seised of a freehold; and he may make a lease thereof for 21 years, or three lives, if it is made according to the statute. 32 Hen. VIII. c. 28.

The husband also gains a chattel real, as a term for years, to dispose of if he pleases by grant or lease in her life-time, or by surviving her: otherwise it remains with the wife. And upon execution for the husband's debt, the sheriff may sell the term during the life of the wife.

The husband also by the marriage has an absolute gift of all chattels personal in possession of the wife in her own right, whether he survives her or not. But if these chattels personal are choses in action, that is, things to be sued for by action, as debts by obligation, contract, or the like, the husband shall not have them, unless he and his wife recover them.

By custom in London, a wife may carry on a separate trade; and as such, is liable to the statutes of bankruptcy with respect to the goods in such separate trade, with which the husband cannot intermeddle.

If the wife is indebted before marriage, the husband is bound afterwards to pay the debt, living with the wife; for he has adopted her and her circumstances together. 1 Black. 143. But if the wife dies, the husband shall not be charged for the debt of his wife after her death, if the creditor of the wife does not get judgment during the coverture. 9 Co. 72.

The husband is bound to provide his wife necessaries; and if she contracts for them, he is obliged to pay for the same; but for any thing besides necessaries, he is not chargeable And also if a wife elopes, and lives with another man, the husband is not chargeable even for necessaries; at least if the person who furnishes them is sufficiently apprised of her elopement.

A man having issue by his wife born alive, shall be tenant by the courtesy of all the lands in fee simple, or fee tail general, of which she shall die seised.

And after her death he shall have all chattels real; as the term of the wife, or a lease for years of the wife, and all other chattels in possession; and also, all such as are of a mixed nature (partly in possession and partly in action), as rents in arrear, incurred before the marriage or after; but things merely in action as of a bond or obligation to the wife, he can only claim them as administrator to his wife, if he survive her.

If the wife survives the husband, she shall have for her dower the third part of all his freehold lands: so she shall have her term for years again, if he has not altered the property during his life: so also she shall have again all other chattels real and mixed: and so things in action, as debts shall remain to her, if they were not received during the marriage.

But if she elopes from her husband, and goes away with her adulterer, she shall lose her dower, unless her husband had willingly, without coercion ecclesiastical, been reconciled to her, and permitted her to cohabit with him.

HUSBANDRY. See AGRICULTURE.

HYACINTH, in natural history, a genus of pellucid gems, whose colour is red with an admixture of yellow.

HYACINTHUS, a genus of the monogynia order, in the hexandria class of plants, and in the natural method ranking under the 10th order, coronariæ. The corolla is campanulated, and there are three melliferous pores at the top of the germen. There are 17 species, of which the most remarkable is the orientalis, or eastern hyacinth. Of this there are a great number of varieties, amounting to some hundreds, each of which differs from the rest in some respect or other. These plants are cultivated with the greatest success in Holland, whence great numbers are annually imported into Britain.

HYALITE. Colours yellowish and greyish-white. Generally small reniform, botroidal, or stalactitic. Lustre splendent. Fracture small conchoidal. Translucent. Moderately hard. Sp. gr. 2.2. Infusible before the blowpipe. Its constituents are, 92 silica, 6.33 water. It has been hitherto found principally near Frankfort on the Maine, where it occurs in fissures in vesicular basalt and basaltic greenstone.

HYBERNACULUM, in botany, that part of the plant which defends the embryo-herb from injuries during the severities of winter, hence the name, hybernaculum or winter quarters.

HYBLÆA. See PHALÆNA.

HYDRA, in astronomy, a southern constellation imagined to represent a water-serpent. The number of stars in this constellation in Ptolemy's catalogue is 25, and in the Britannic catalogue 68.

HYDRA, a genus of vermes zoophyta. The generic character is, animal fixing itself by the base, linear, gelatinous naked contractile, and

furnished with setaceous tentacula, inhabiting fresh water, and producing its deciduous offspring, or eggs, from the sides. The hydra-viridis inhabits the stagnant waters and slowly-running streams of Europe, generally on the surface of plants, and appears like a little transparent green jelly, when contracted and transparent: when expanded it is a linear body, fixed at one end, and surrounded at the other by tentacula, or arms placed in a circle round the mouth, and gradually producing its young from the sides, which at first seem small papillæ, increasing in length, till they assume the form of the parent, and then dropping off. Like all its tribe, it has the power of reproducing parts, which have been destroyed, and if cut or divided in any direction, each separate part becomes a perfect polype. See Adams on the Microscope. There are five species.

HYDRARGYRUM, a name given in the Pharmacopeia to mercury or quicksilver.

HYDRANGEA, a genus of the digynia order, in the decandria class of plants, and in the natural method ranking under the 13th order, succulentæ. The capsule is bilocular, birostrated, and cut round, or parting horizontally. There are three species, of which the hortensis is a very handsome, and now a popular greenhouse plant.

HYDRATES. Compounds, in definite proportions, of metallic oxides with water.

HYDRAULICS. This branch of science embraces the phenomena exhibited by water issuing from orifices in reservoirs, projected obliquely or perpendicularly in jets-d'eaux, moving in pipes, canals, and rivers, oscilating in waves, or opposing a resistance to solid bodies.

GENERAL PRINCIPLES.

When water flows from a vessel which has a hole or aperture in the bottom, small in comparison to the width of the vessel, the water descends vertically, and the surface appears smooth, but at three or four inches from the bottom the particles turn from this direction, and proceed on all sides with a motion more or less oblique towards the aperture. The same effect takes place when water flows through an aperture laterally. The tendency of the particles towards the aperture is a necessary consequence of their perfect mobility; for they will certainly be directed towards the point where there is the least resistance, and that point is the aperture.

It is also to be observed, that in this case, at a small distance from the bottom, a kind of funnel is formed in the water, the point of which corresponds to the centre of the aperture; when, however, the water flows through a lateral orifice or aperture, there is formed only a kind of half funnel, which does not appear to commence till the surface is near touching the upper side of the hole. It is probable that the funnel begins to form itself from the first moment of the flow; but it does not become perceptible till the surface is only at a small distance from the bottom. It appears also, that the funnel commences higher or lower, according to the width of the bottom; and that the formation of it is less prompt or less perceptible, according to the proportion of the aperture to the extent of the bottom. The funnel is also augmented by any roughness which may exist at the sides or bottom of the vessel.

Water flows out of a small hole in the bottom of a vessel with a velocity equal to that which a ponderous body acquires in falling from a height equal to the vertical height of the surface of the fluid above the aperture.

The same law takes place in a lateral orifice; for the pressure of the fluid is equal (at the same depth) in all directions, and consequently produces the same degree of velocity.

A fluid in running out of an aperture, acquires a velocity sufficient to make it remount to a vertical height equal to that of the fluid above the aperture, in the same manner as a falling body acquires a velocity capable of making it ascend to the height from which it descended.

It is evident, from the theory of falling bodies, that if the velocity of the fluid in running through the aperture was uniformly continued, the fluid would move through a space double the height of the fluid above the aperture, in the same time that a falling body would employ in descending from that height.

The height being the same, the velocity of the fluid in running out of the orifice will always be the same, whatever the species of the fluid may be, and whatever its density. It is true, that when the fluid has more density, it presses more forcibly, but then the mass is more considerable; and it is evident, that when the moving powers are proportioned to the masses which they put in motion, the velocities are equal.

The quantities of a fluid discharged in the same space of time through different orifices, supposing the vessels equally full during the whole of the experiment, are to each other as the products of the areas of the apertures by the square roots of the heights.

It is found by experiment, that a circular orifice of an inch diameter, made in a thin vessel or partition, and under a surface of fluid four feet in height, will furnish, in one minute of time, 5436 cubic inches French.

If, therefore, it were an object to ascertain how much a circular orifice of two inches diameter, under nine feet of height from the surface of the water, would furnish in the same, the following proportion must be employed, (it must be observed, that the orifice of two inches is four times as great as an orifice of one inch, because the areas of circles are as the squares of their diameters:)

$$1 \times \sqrt{4} : 4 \times \sqrt{9} :: 5436 : x$$

Or at length

$$2 : 12 :: 5436 : 32616$$

$$\begin{array}{r} 12 \\ \hline 2)653232 \\ \hline \end{array}$$

The reader ought here to be reminded that in every branch of hydraulics the deductions of theory are extremely uncertain, and, indeed, of but little use in any of the important purposes to which this science is applicable, the general laws deduced from experiment can alone be safely employed.

The motion of fluids, and the friction and other causes by which they are impeded, form together one of the most elaborate and abstruse branches of mathematical philosophy, and would, we fear, prove very uninteresting to the generality of our readers.

The following rule, as stated by Professor

Millington, will be found sufficiently correct for most practical purposes, and its extreme simplicity not a little enhances its value

It may be practically assumed that water may flow through straight pipes of from 2 to 7 inches diameter, when lying horizontally, at the rate of 3 feet in a second, without much loss of power from friction, unless the length of the pipes be very considerable, and consequently to calculate the quantity of water that a pipe will deliver in a given time, it is only necessary to calculate the solid contents of a yard of any pipe in cubic inches, or any other measure of capacity, and to multiply this by the number of seconds contained in the given time, in order to obtain the delivery. Now, if the diameter in inches of any pipe be squared, and the right-hand figure of its square number be cut off by a decimal point, such square number will be the contents of a yard of such pipe in ale gallons and tenths. Thus, if a pipe is 6 inches in diameter, its square will be 36, which being divided as above makes 3.6, and shews that one yard of such pipe contains 3 gallons and 6 tenths. If the pipe were but two inches diameter, then its square 4 consists but of one figure, and must be considered as a decimal, thus .4 indicates that the contents of a yard of such pipe contains 0.4 four tenths of 1 gallon.

The nature of the motion, lateral pressure, gravity and momentum of fluids being investigated by the mathematical principles of hydraulics and hydrostatics, the construction of mechanical engines, for raising or moving water, and for procuring disposable power from its agency, follow as natural consequences.

In the formation of these, Mr. Millington observes, it must be kept in mind that water has a constant tendency to descend, which affords the principal resistance to be overcome in the one case, and the source of power in the other; and as water can never rise above its ordinary level, except by some extraneous force, so likewise in descending it can never produce a power equal to the elevation of more than its own quantity to a height equal to that from whence it flowed, since that would be contrary to the laws of hydrostatic equilibrium.

We shall now proceed to describe a few of the most useful and simple hydraulic machines.

Of the syphon.

A syphon is a bent tube, ABC, (Plate XXIII. fig. 1.) made of glass, metal, &c. One branch of which AB, is shorter than the other BC. In order to make use of this instrument, place the extremity of the short branch in the vessel A, which may be supposed to contain any fluid matter, as water for instance. If the air then is drawn out of the syphon (fig. 2.) by means of the long branch *x*, the liquor will begin to flow, and will not cease while the short branch AB remains immersed in the fluid. It is easy to see that the pressure of the air upon the surface of the fluid in the vessel, is the cause of its discharge through the siphon. For suppose GF the confines of the atmosphere, all the points of the surface A of the liquor will be equally pressed by the column of air AF; if, therefore, at some point of this surface, the pressure is suspended, the liquor must flow at that point, because it finds less resistance there than in any other part; this is therefore the obvious reason why the syphon becomes full immediately after the air is drawn out at the extremity C.

If the two branches of the syphon were of equal lengths, as BA, BD, the flow through the bent tube would not take place; because the column of air DG which would resist in D, being of an equal height with that which presses at A, would also be in equilibrium with it, in the same manner as the two columns of the fluid BA, BD. But since BC, one of the legs, is longer than the other, though the column of the air GC, which answers to it, is really longer than that which presses in A; yet it is not capable of preventing the passage of the fluid. To understand this more perfectly, let us consider the column of air GC to be divided into two parts, one of which GD, would form an equipoise with the column of air FA, and would be capable of stopping the flow from the tube if the branch BC ended in D. The portion of fluid which fills the part DC of the siphon, will find no other resistance in C than one coloumn of air DC of the same length with it, which is evidently very inferior to it in weight. This portion of fluid then flows out, because it greatly exceeds in weight the column of air which is opposed to it. But while it continues to flow, nothing sustains that which is above it, which flows necessarily, while the pressure of the air at A furnishes a new supply of fluid to replace that which runs out. It is by these means, that the water in the syphon continues to flow without intermission; because the resistance of the air in C is as much exceeded, as the length of the branch BC of the syphon exceeds that of the branch AB. In order to prove this, suppose there is added at C a tube to lengthen that branch, then it will plainly appear that in a given time more water will flow than would have been discharged without that augmentation to the branch BC.

Since it is the pressure of the air which elevates the fluid in the short branch BA, it follows, that the height of this branch is limited to thirty-two feet when the fluid is water, because the pressure of the atmosphere cannot elevate water higher; but when the liquor is mercury, the height of the short branch should not exceed thirty inches, because the atmosphere cannot sustain mercury at a greater height.

A syphon may be disguised in a cup, (fig. 3.) from which no liquor will flow, until it be raised above the bend of the syphon; but when the efflux once begins, it will continue to flow till the vessel be emptied. This has been called Tantalus's cup, because it is usual to place a hollow figure over the inner tube of such a length, that when the fluid has got nearly up to the lips of the figure, the syphon may begin to act and empty the cup.

Intermitting springs, which puzzled philosophers formerly, are found to be natural syphons, which may be thus explained: Let A (fig. 4.) be part of a hill, within which there is a cavity BB, and from this cavity, a vein or channel running in the direction BCD. The rain that falls upon the side of the hill will sink and strain through the small pores and crevices in the hill, and fill the cavity BB with water. When the water rises to the level of C, the vein BCD will be full, and the water will run through it as a syphon, and will empty the

cavity BB. It must then stop, and when the cavity is again filled, it will begin to run again.

The principal use to which the syphon is applied, is that of drawing off liquors from one vessel to another, as represented in fig. 5.

Of the Pump.

There are two sorts of pumps, which essentially differ; and all the varieties are but modifications of these. One has a piston with a perforation and valve; the other has a solid piston; to the former is given the name of the common sucking-pump; the latter is denominated the forcing-pump.

Fig. 6 represents the common sucking-pump. AA is a cylinder of cast iron, bored smooth withinside; it has a flanch at the top, by which it is screwed to the wooden cistern B, which conveys the water away from the pump. It has also a flanch D at its lower end, to screw on the pipe E, which brings the water to the pump. In the same flanch is a pair of valves, *aa;* and the bucket or piston F, which slides within the barrel, has another similar pair of valves in it. This bucket is screwed to an iron rod G, which is moved up and down by some machine. When the bucket F descends, its valves *bb* open as in the figure, and allow the water which fills the barrel to pass through them. When the bucket arrives at the bottom of the barrel, it is drawn up again; and as the valves shut, and prevent the water from returning through the bucket, it lifts all the water contained in the barrel into the cistern B. At the same time the bucket, in rising, makes a vacuum beneath it: the pressure of the atmosphere upon the surface of the water in the well, causes it to mount up through the pipe E, open the valves *aa*, and fill the barrel AA. When the bucket begins to descend, the column of water beneath it descends also, till it is stopped by the shutting of the valves *aa*; the valves *bb* then open, and allow the water to pass through as before.

Fig. 7 is a forcing-pump. In this the barrel AA is screwed upon a square box BB, which has a pair of valves *aa* at the top of the pipe C, bringing water from the well; and another similar pair at the other end of the pipe D, which is likewise screwed to the square box. The plunger E is solid: when it is drawn up it makes a vacuum in the barrel, and draws the water up through the valves *aa* from the well to fill the barrel. The plunger is then forced down, the valves *aa* shut, and as the water has no other way out of the box, it passes through *bb* up the pipe D. The plunger is then drawn up, the valves *bb* shu,t and *aa* open to supply the barrel as before.

Fig. 8 is a lift-pump. The barrel AA is screwed by its top to a shorter barrel H, from which the crooked pipe B proceeds. A cover *h* is screwed over the top of the barrel H, with a stuffing-box in the middle of it; which is a box containing cotton, or other light substances, through which the piston-rod E passes. The piston F has two valves *bb* in it, similar to fig. 1; and at the bottom of the barrel are two valves similar to *aa* (fig. 6.) When the piston descends, the lower valves prevent the water from going out of the barrel: and the valves *bb* open, to let the water pass through them. When the piston returns, the valves in it shut, and it raises the water through the pipe B, the stuffing-box preventing its getting out at the top of the barrel, by the side of the piston-rod, as in fig. 1; and at the same time, by making a vacuum beneath it, filling the barrel through the lower valves in the same manner as the sucking-pump. The piston then descends, the lower valves shut, and *bb* open as before. In all the figures, W represents a hole in the bottom of the pump, to get at the valves to repair them, and when the pump is at work, a cover is screwed over it, as shewn in fig. 3. Pumps constructed as in the drawings are seldom less than one or two feet in the bore of the barrel.

That eminently useful engine termed the *fire-engine*, or more properly, the fire extinguishing engine, is nothing more than two forcing pumps so combined, that their joint action produces a constant and powerful stream of water, which may be directed at pleasure towards the point at which it is wanted.

The most approved construction of the fire-engine is, we believe, that of the ingenious Mr. Rowntree. It consists of a double force pump of a peculiar construction, similar in its action to the well known beer engine, by the same inventor.

From the following short description of the section of this engine, exhibited in fig. 9 the reader will be enabled to comprehend the nature of its action. AAAA is a cast-iron cylinder truly bored, being 10 inches in diameter, and 15 inches long. At each end there is a flanch, on which are screwed two covers with stuffing-boxes, *aa* in their centres, through which the spindle BB of the engine passes: the piston D is affixed to the spindle within the cylinder, and fits it tight all round by means of leathers. At E, a partition called a saddle is fixed in the cylinder, and fits on the back of the spindle tight by a leather. The cylinder is thus divided by the saddle E and the piston D into two parts, the capacity of which can be increased or diminished by moving the piston, with proper passages and valves to bring in and carry away the water; this forms a pump. These passages are cast in one piece with the cylinder; and *d*, for admitting the water is square, and extends about one-third round the cylinder; it is connected at bottom with the pipe *e*; at its two upper ends, it opens into two large chambers, *f g*, which extend nearly the whole length of the cylinder, and are closed by covers, *h*, *h*; *i*, *k*, are square openings in the cylinder communicating with the chambers, *f*, *g*; *l*, *m*, are two valves, closing their respective ends of the curved passage *d*; *n*, *o*, are two passages from the top of the cylinder, to convey away the water; they come out in the top of the cylinder, which, together with the top of the chambers *f*, *g*, form a flat surface, and are covered with two valves, *p*, *q*, to retain the water which has passed through them. A chamber, K, is screwed over these valves and has the air vessel *k*, as seen in the elevation of the engine fig. 10, screwed into its top. From each side of this chamber, a pipe, *w*, *w*, proceeds, to which a leathern hose is screwed to conduct the water to the directing pipe. Levers marked *x x*, are fixed to the spindle at each end, and carry the handles H, H, by which men work the engine. When the piston moves, as shewn by the arrow, it produces a vacuum in the chamber *f*, and in that part of the cylinder contiguous to it; the water in the pipe *e*, then opens the valve *m*, and fills the cylinder.

The same motion forces the water in the other part of the cylinder through the valve *g*, into the chamber K, and thence to those through the pipe *w*; the piston being turned the other way, reverses the operation with respect to the valve, though it continues the same in itself.

The chambers, *f*, *g*, being so large, allow sufficient room to lodge a greater quantity of dirt than is likely to be accumulated in the use of the engine at any one fire, and if any of it accidentally falls into the cylinder, it is gently lifted out again into the chambers by the piston, without being any obstruction to its motion; to clear the engine from the dirt, two circular plates, *r*, *r*, five inches diameter, are unscrewed from the lids, *h*, *h*, of the chambers, *f*, *g*, and when cleaned are screwed on again: these screw covers fit perfectly tight without leather, and can be taken out, the engine cleared, and enclosed again in a very short time. Besides the engines described above, we might enumerate many others, such as the spiral-pump of Archimedes; the tympanum of Vetruvius; the Persian wheel; the hydraulic ram of Montgolfier; the chain-pump and hair-rope machine; Whitehurst's engine; the Hungarian machine, &c.; but to describe these would swell this article far beyond its proper limits. The hydraulic press will be found shortly described, under the article HYDROSTATICS, which see.

HYDRAULICON, *water organ*, in music, an instrument acted upon by water, the invention of which is said to be of higher antiquity than that of the wind organ.

HYDROCELE, in surgery, denotes any hernia arising from water, but is particularly used for such a one of the scrotum, which sometimes grows to the size of one's head, without pain, but very troublesome to the patient.

HYDROCEPHALUS, in surgery, a preternatural distention of the head to an uncommon size, by a stagnation and extravasation of the lymph, which when collected within side of the bones of the cranium, the hydrocephalus is then termed internal; as it is external, when retained between the common integuments and the cranium.

HYDROCHARIS, the *little water-lily*, a genus of the enneandria order, in the diœcia class of plants, and in the natural method ranking under the first order, palmæ. There is only one species, a native of Britain, growing in slow streams and wet ditches. There is a variety with double flowers, of a very sweet smell.

HYDROGEN GAS. The lightest species of ponderable matter hitherto known. It was discovered by Mr. Cavendish in 1766. It can be procured only from water, of which it forms an essential constituent.

This gas is colourless, and possessed of all the physical properties of air. It has usually a slight garlic odour, arising probably from arsenical particles derived from the zinc. When water is transmitted over pure iron in a state of ignition, it yields hydrogen free from smell. It is eminently combustible, and, if pure, burns with a yellowish-white flame; but, from accidental contamination, its flame has frequently a reddish tinge. If a narrow jar filled with hydrogen be lifted perpendicularly, with the bottom upwards, and a lighted taper be suddenly introduced, the taper will be extinguished, but the gas will burn at the surface, in contact with the air. Animal life is speedily extinguished by the respiration of this gas, though Sir H. Davy has shewn, that if the lungs be not previously exhausted by a forced expiration, it may be breathed for a few seconds without much seeming inconvenience.

If a bottle containing the effervescing mixture of iron and dilute sulphuric acid, be shut with a cork, having a straight tube of narrow bore fixed upright in it, then the hydrogen will issue in a jet, which being kindled, forms the philosophical candle of Dr. Priestley. If a long glass tube be held over the flame, moisture will speedily bedew its sides, and harmonic tones will soon begin to sound. Mr. Faraday, in an ingenious paper inserted in the 10th number of the Journal of Science, states, that carbonic oxide produces by the action of its flame, similar sounds, and that therefore the effect is not due to the affections of aqueous vapour, as had formerly been supposed. He shews, that the sound is nothing more than the report of a continued explosion, agreeably to Sir H. Davy's theory of the constitution of flame. Vapour of ether, made to burn from a small aperture, produces the same sonorous effect as the jet of hydrogen, of coal gas, or olefiant gas, on glass and other tubes. See CHEMISTRY.

HYDROMETER. The names *aereometer*, *hydrometer*, *gravimeter*, have been indiscriminately applied to those instruments which are employed for determining the specific gravities of spirituous liquors and other fluids.

The best method of weighing equal quantities of corrosive volatile fluids, to determine their specific gravities, appears to consist in enclosing them in a bottle with a conical stopper, in the side of which stopper a fine mark is cut with a file. The fluid being poured into the bottle, it is easy to put in the stopper, because the redundant fluid escapes through the notch, or mark, and may be carefully wiped off. Equal bulks of water, and other fluids, are by this means weighed to a greater degree of accuracy, care being taken to keep the temperature as equal as possible, by avoiding any contact of the bottle with the hand or otherwise. The bottle itself shews with much precision, by a rise or fall of the liquid in the notch of the stopper, whether any such change have taken place.

The hydrometer of Fahrenheit consists of a hollow ball, with a counterpoise below, and a very slender stem above, terminating in a small dish. The middle, or half length of the stem, is distinguished by a fine line across. In this instrument every division of the stem is rejected, and it is immersed in all experiments to the middle of the stem, by placing proper weights in the little dish above. Then, as the part immersed is constantly of the same magnitude, and the whole weight of the hydrometer is known, this last weight added to the weights in the dish, will be equal to the weight of fluid displaced by the instrument, as all writers on hydrostatics prove. And accordingly, the sp. gravities for the common form of the tables will be had by the proportion:

As the whole weight of the hydrometer and its
load, when adjusted in distilled water.
Is to the number 1000, &c.
So is the whole weight when adjusted in any
other fluid.
To the number expresing its specific gravity

There are various kinds of hydrometers in

use, but that of Sikes appears to be the most generally approved, since it is universally used in the collection of the revenue in both kingdoms.

HYDROPHILUS, in natural history, a genus of insects of the order coleoptera, antennæ clavate, the club perfoliate; feelers four, filiform; the hind legs are formed for swimming, fringed on the inner side, and nearly unarmed with claws. The insects of this genus,) like those of the DYTISCUS, which see,) are inhabitants of ponds and stagnant waters, where they swim with much dexterity, turning round with great velocity; they fly abroad by night in search of other waters. The males are distinguished from the females, by having a horny concave flap or shield on the fore legs, near the setting on of the feet; the hind legs are peculiarly fitted for their aquatic situation, being furnished on the inner side with a series of long and close-set filaments, resembling a fin, by which they are enabled to swim with great ease.

HYDROPHOBIA, from ὑδωρ, *water*, and φοβεω, *to fear*, a dread of water; a symptom of the disease caused by the bite of a mad dog.

Both the cause and the cure of this terrible disorder seem as yet involved in impenetrable obscurity.

HYDROSCOPE, an instrument anciently used for the measuring of time. The hydroscope was a kind of a water-clock, consisting of a cylindrical tube, conical at bottom: the cylinder was graduated, or marked out with divisions, to which the top of the water becoming successively contiguous, as it trickled out, the vertex of the cone pointed out the hour.

HYDROSTATICAL *balance*, a kind of balance contrived for the easy and exact finding the specific gravities of bodies, both liquid and solid. See HYDROSTATICS.

HYDROSTATICS. The science of hydrostatics, has for its object the examination of the mechanical laws which regulate the motions, pressure, gravitation, and equilibrium of inelastic fluids, and also their effect on those bodies which float upon, or are immersed in them.

Archimedes, among the ancients, accomplished the most remarkable discoveries in this science. He is honoured even at this day, as the inventor of the ingenious hydrostatic process, by which the purity or baseness of a crown of gold was ascertained. Among the moderns we are indebted to Gallileo, Torricelli, Descartes, Pascal, Guglielmini, and Mariotte, for the best information on this subject; and by their experiments (which are as curious as they are decisive) we are instructed in what we may expect or fear from the power of fluids violently acted upon by the principle of gravity, and in what manner, and upon what principles we may employ, for the use of man, the hydraulic machines.

The propensity which bodies have of approaching towards the earth, is the only cause of what we term weight or gravity, and it is by the continual efforts which they make to obey that law, that they press upon every obstacle which impedes their progress. As fluids, like solid bodies, are impelled by their gravity, so in this case they press upon every object which opposes their fall; but from their nature they press in a different manner from solid bodies.

Fluids are substances, the component parts of which are moveable among themselves, having scarcely any cohesion one with another, and moving independently of each other. The proper objects of the hydrostatic science are those fluids which, in common language, are termed liquids, or those which always present to us a plain surface, level or parallel to the horizon.

All liquid substances are not equally so. Water and oil both flow when the vessels, which contain them, are either overturned or broken; but the effusion of oil is slower than that of water, because the particles of oil have more cohesion among themselves. The most singular effects in hydrostatics principally depend, perhaps, upon the extreme minuteness of the particles of fluids, but at least upon their great mobility.

To preserve order in the consideration of this subject, it will be necessary to divide the objects of our inquiry into three branches. In the first place, we shall consider in what manner the principle of gravity acts on the particles of fluids, and the phenomena which it produces in the fluids themselves; as well as their action against the sides, the bottoms, and tops of the vessels in which they are contained. Secondly, in what manner fluids of different densities act upon each other; and thirdly, the action of fluids on bodies immersed in them.

I. In pursuing the first object of this inquiry, it may be established as an axiom:

1. That the parts of the same fluid act, with respect to their weight or pressure, independently of each other.

This property arises from their having scarcely any cohesion among themselves. It is otherwise with solid bodies; their several parts adhering together, they press in one common mass; hence the falling of solid bodies is productive of a different effect from that of liquids. We dread the falling of a pound of ice upon our heads, while we are much more indifferent concerning that of a pound of water. The latter, in its descent, is divided by the resistance of the air, by which some of its parts are retarded more than others: and by being thus divided it requires a larger surface, which abates its effect. On the contrary, a solid body falls upon a small space, which receives its whole force.

It follows from this principle, that if an aperture is made at the bottom of a vessel full of any fluid, in order to prevent the flowing out of the liquor, it is only necessary to counteract the weight of that column of fluid which has the aperture for its base, and that to counteract that weight it is the same whether the vessel is full of liquor, or whether it contains only a column, the base of which shall be equal to the aperture at the bottom.

Let the cylindrical vessel of glass A B, (Plate XXIV. fig. 1,) have a hole in the bottom at C, furnished with a cylindrical ferule of copper of an inch diameter D, which is to be stopped with a piston G, well fitted to the ferule, and oiled, that it may yield to a moderate pressure. Let the piston be supported by a small rod G H, fastened at H to the silk which unites with the portion of the pulley M. with which the extremity of the lever M N is furnished,

and which has for its centre of motion the point L. The other portion of the pulley N, which terminates the other extremity of the lever, is also furnished with lines of silk, which support the small bason or scale I. Upon the copper ferule D, fit a cylindrical tube of glass FE, the interior diameter of which is equal to that of the ferule, and its height equal to that of the vessel AB. When the apparatus is disposed in this manner, fill the tube EF with water, and continue to put small weights into the scale I, until the piston begins to rise. Afterwards take away the glass tube EF, and place the piston G in the copper ferule O, and pour water into the large vessel AB, and it will appear that the same weights as before in the bason I, will raise up the piston when the large vessel AB is entirely full. Hence it follows that there is the same power to be counteracted, whether there rests upon the piston only a column of water of its own size, or whether the vessel AB is entirely full. Such a column, therefore, presses upon its base, independently of the rest of the water contained in the vessel.

To account for this, let us suppose all the water in a vessel to be divided into several columns, 1, 2, 3, 4, 5, (fig. 2,) each composed of an equal number of parts. If the bottom of the vessel is opened in *a*, the column 3, being no longer supported, will descend through the aperture, sliding between the two columns 2 and 4, which are supported by the parts of the bottom of the vessel *b* and *c*, all the moveable parts of which become, so to speak, small rollers, which retard the fall only in a very slight degree. This effect is the result of the small degree of cohesion between the parts of the fluid. If the columns 1 and 2 on the one part, and 4 and 5 on the other, were composed of parts adhering together, they would retard each other in their descent during their whole length; and by the fall of the column 3, a void would be made between them. But as all the particles are extremely minute, moving easily upon each other, they descend when the summit of the column 3 begins to descend having no longer any support from that side: and the superfices of the whole mass descends in the same manner.

2. Fluids press equally in all directions. In other words, they not only press from the top to the bottom, like other bodies, but they also press according to their weight, upon all bodies that oppose them in a lateral direction, and even from the bottom to the top. Hence, if a cask is filled with liquid oil, the oil will run out if an aperture is made in the side, but when it is congealed it will not run out on account of its having become a solid body, for solid bodies press only from their vertex to their base, and not laterally.

To understand this lateral pressure of fluids, and also that which they exert from their base towards their vertex, it is necessary to consider them as a mass of small globules deposited in a vessel: and to remember that these minute globules are not arranged regularly as upon a cord, but that very frequently one column exercises its pressure between two others, and has a propensity to displace them, as may be seen in fig. 3, where the perpendicular pressure, which is made opposite to the point *d*, is directed by the lateral columns towards the sides *e*, *f* of the vessel, in such a manner, that if the vessel was open in those places the liquid would flow out, on account of the great mobility of its parts. It is by the same mode of reasoning that the pressure of fluids, from their base towards their vertex, is accounted for.

3. All the parts of the same fluid are in equilibrium with each other, whether they are contained in one vessel or many, provided they communicate with each other; and their surfaces also are always in a plane parallel to the horizon.

This is a consequence of the principle which has been before established; for, since the particle *k*, fig. 3, would be raised from the base towards the top, unless a column equal to the column *i k* pressed upon it to retain it in its place; it follows, that to be in equilibrium, the upper extremities of the two columns should be in the same horizontal plane, or in points equally distant from the centre of the earth; which points, however, cannot be found by a right line; for in the distance of a thousand fathoms there is about one foot difference in the perpendicular height. It follows from the equal pressure of fluids in all directions, that the horizontal bottom of a vessel sustains just the pressure of a column of the fluid, whose base is the area of the bottom of the vessel, and whose perpendicular height is equal to the depth of the fluid. Thus in the vessel ABC, fig. 4, the bottom BC does not sustain a pressure equal to the whole quantity of fluid contained in the vessel, but only of a column whose base is CB, and height CE. Also in the vessel FGH, the bottom GH, fig. 5, sustains a pressure equal to what it would be if the vessel were as wide at the top as at the bottom.

This leads us to notice what is called the hydrostatical paradox, which is thus expressed, "that a quantity of fluid, however small, may be made to counterpoise a quantity however large." Thus, if to the wide vessel AB, fig. 6, the tube CD is attached, communicating with AB, and then water be poured into either of them, it will stand at the same height in both, consequently there is an equilibrium between them. It may thus be illustrated: Let ABDG, *fig.* 7, represent any cylindrical vessel, to the inside of which is fitted a cover C, which will slide up and down without suffering any water to pass between the edges. In the cover is inserted a small tube, CF, which is open at top, and communicates with the inside of the cylinder beneath the cover at C. The cylinder is filled with water, and the cover put on. Then if the cover is loaded with a weight, as a pound, it will be depressed, and the water rise in the tube to E, and the weight will be sustained. If another weight be added, the water, will rise to F, and the weight sustained, and so on, according to the weight added, and the length of the tube. Now the weight of the water in the tube is but a few grains, yet its lateral pressure serves to sustain as much as the weight of a column of water whose base is equal to that in the tube. Thus the column E d produces a pressure in the water contained in the cylinder, equal to what would have been produced by the column A a D d; and as this pressure is exerted equally every way, the cover will be pressed upwards with a force equal to the weight of A a d D; consequently if A a d D weigh a

pound, EC will sustain a pound: and the like of any other heights and weights.

The instrument commonly employed to shew that a small quantity of water is capable of exerting great pressure, is called the hydrostatic bellows. The use of this machine is now nearly laid aside; and an excellent substitute for it is found in the simple invention of the ingenious Ferguson, of which the following is his own description.

In fig. 8, ABCD is an oblong square box, in one end of which is a round groove, as at *a*, from top to bottom, for receiving the upright glass tube I, which is bent to a right angle at the lower end, as at *i* in fig. 9, and to that part is tied the neck of a large bladder K, which lies in the bottom of the box. Over this bladder is laid the moveable board L, fig. 10, in which is fixed an upright wire M; and leaden weights NN, to the amount of sixteen pounds, with holes in their middle, which are put upon the wire, over the board, and press upon it with all their force. The cross bar *p* is then put on, to secure the tube from falling, and keep it in an upright position; and then the piece EFG is to be put on, the part G sliding tight into the dove-tailed groove H, to keep the weights NN horizontal, and the wire M upright; there being a round hole *e* in the part EF for receiving the wire. There are four upright pins in the four corners of the box within, each almost an inch long, for the board L to rest upon: to keep it from pressing the sides of the bladder below it close together at first.

The whole machine being thus put together, pour water into the tube at top; and the water will run down the tube into the bladder below the board; and after the bladder has been filled up to the board, continue pouring water into the tube, and the upward pressure which it will excite in the bladder, will raise the board with all the weight upon it, even though the bore of the tube should be so small, that less than an ounce of water would fill it.

Although this principle of the upward pressure of water was known to the ancients, it was never applied to any useful purpose till the late Mr. Joseph Bramah constructed on it the well-known *hydraulic press*, which is now so extensively used where great pressure is required. Of this amazingly powerful machine, we shall here give a brief description. Fig. 11 is a section of one of one of these presses, in which *t* is the piston of the large cylinder, formed of a solid piece of metal, turned truly cylindrical, and carrying the lower board *v* of the press upon it; *u* is the piston of the small forcing pump, being also a solid piece of metal of a cylindrical form, and moved up and down by the handle *w*; the whole lower part of the press is sometimes placed in a case *x x*, containing more than sufficient water, as at *y*, to fill both the cylinders, and the suction pipe of the forcing pump *u*, dipping into this water will be constantly supplied. When the handle *w* moved upwards, the water will rise through conical metal valve *z*, opening upwards into the bottom of the pump *u*, and when the handle is depressed, that water will be forced through another similar valve *a*, opening in an opposite direction in the pipe of communication between the pump and the great cylinder *b*, which will now receive the water, by which the piston rod *t* will be elevated at each stroke of the pump. Another small conical valve *c*, is applied by means of a screw to an orifice in the lower part of the large cylinder, the use of which is to release the pressure whenever it may be necessary, for on opening this valve, any water which was previously contained in the large cylinder *b*, will run off into the reservoir *y*, by the passage *d*, and the piston *t*, will descend, so that the same water may be used repeatedly.

This machine not only acts as a press, but is capable of many other useful applications, such as a jack for raising heavy loads, or even buildings;—to the purpose of drawing up trees by their roots, or the piles used in building.

Upon the principle of the upward pressure of fluids, a piece of lead may be made to swim in water, by immersing it to a proper depth, and keeping the water from getting above it. Let CD, fig. 12, be a glass tube open throughout, and G a flat piece of lead half an inch thick, fitted exactly to the lower end of the tube, but not to go within it. By means of the packthread L, the lead is held close to the bottom of the tube, and in this situation it is immersed in the water of the vessel K to somewhat more than eleven times its own thickness, because lead is more than eleven times heavier than water; then the thread L may be let go, but the lead will not fall, but be sustained by the upward pressure of the water below it. If some water be poured upon the lead, or if the tube be raised a little, the lead will fall by its own weight, which will then be too heavy for the pressure of the water round the tube, upon the column of water below it.

II. The effects of gravity on fluids of different densities, will, from what has preceded, not be very difficult to comprehend.

If two fluids of different densities are placed in a state of equipoise with each other, and have the same base, their perpendicular heights above the horizon will be in a reciprocal ratio to their densities or specific gravities.

If, for example, mercury is put into an inverted syphon, and water is poured into one of the branches. in order to elevate the mercury in the other branch one inch above its level, it is necessary that the water should be about thirteen inches and a half high. The height of the water then will be thirteen times and a half that of the mercury; because the specific gravity of mercury is about thirteen times and a half as great as that of water.

III. The action of fluids on solid bodies immersed in them forms the doctrine of specific gravity.

When a solid body is plunged into a fluid, it occupies a space in that fluid exactly equal to its own magnitude. The quantity of fluid then so displaced, either equals in density, and consequently in weight, the solid which displaced it; or, on the contrary, one of the two must weigh more than the other. In the last case which is most common, the quantity by which the heavier body surpasses the lighter, is called the specific weight or gravity.

If a body is heavier than the fluid in which it is immersed, it is evident that it will sink to the bottom by its specific gravity. If a body is lighter than the same bulk of the fluid into which it is plunged, a part of it will swim, and the remaining part which is immersed displaces a quantity of fluid, which weighs exactly as much as the whole of the solid body

The instrument used for finding the specific gravities of bodies, is called the hydrostatic balance, fig. 13.

It differs very little from a common balance that is nicely made; only it has a hook at the bottom of one of the scales, on which different substances that are to be examined may be hung by horse-hairs, so as to be immersed in a vessel of water, without wetting the scale.

If a body thus suspended under the scale, at one end of the balance, be first counterpoised in air by weights in the opposite scale, and then immersed in water, the equilibrium will be immediately destroyed; then, if as much weight be put into the scale from which the body hangs, as will restore the equilibrium, without altering the weights in the opposite scale; that weight which restores the equilibrium, will be equal to the weight of a quantity of water as large as the immersed body; and if the weight of the body in air be divided by what it loses in water, the quotient will shew how much that body is heavier than its bulk of water. Thus, if a guinea suspended in air, be counterbalanced by 129 grains in the opposite scale of the balance, and then, on its being immersed in water, it becomes so much lighter as to require 7¼ grains put into the scale over it, to restore the equilibrium, it shews that a quantity of water of equal bulk with the guinea, weighs 7¼ grains, or 7.25; by which divide 129 (the weight of the guinea in air,) and the quotient will be 17.793; which shews that the guinea is 17.793 times as heavy as its bulk of water. And thus, any piece of gold may be tried, by weighing it first in air, and then in water; and if upon dividing the weight in air by the loss in water, the quotient comes out to be 17.793, the gold is good: if the quotient be 18, or between 18 and 19, the gold is very fine; but if it be less than 17, the gold is too much alloyed with other metal. By this method, the specific gravities of all bodies that will sink in water, may be found.

HYDROSULPHURETS, in chemistry. Sulphuretted hydrogen gass possesses the properties of an acid. It is absorbed by water, in considerable quantities, and the solution reddens vegetable blues; it combines also with alkalis and earths, and with several metallic oxides. The combinations which sulphuretted hydrogen forms with bases have been called hydrosulphurets.

HYGROMETER. Hygrometers are instruments which indicate the presence of water in the air, its variation in quantity, and its actual quantity existing in a given bulk of air at any given time. See METEOROLOGY.

HYMENOPTERA, in natural history, the fifth order of insects according to the Linnæan system. The insects of this order are furnished with four membranaceous wings, and also with a sting, or a process resembling one. The wasp and the bee are insects of this order.

HYOSCYAMUS, *henbane*, in botany, a genus of the monogynia order, in the pentandria class of plants; and in the natural method ranking under the 28th order, luridæ. There are eight species, one of which, viz. the niger, or common henbane, is a native of Britain. It grows on road-sides, and among rubbish.

HYPERBOLA, in geometry, the section of a cone made by a plane, so that the axis of the section inclines to the opposite leg of the cone, which in the parabola is parallel to it, and in the ellipsis intersects it. The axis of the hyperbolical section will meet also with the opposite side of the cone, when produced above the vertex. See CONIC SECTIONS.

HYPERBOLE, in rhetoric, a figure, whereby the truth and reality of things are excessively either enlarged or diminished.

HYPNUM, *feather-moss*; a genus of the natural order of musci, belonging to the cryptogamia class of plants. There are fifty species, many of them natives of Great Britain; none of them, however, have any remarkable property, except the proliferum and parietinum.

HYPOTHECATE, in law, to hypothecate a ship, is to pawn it for necessaries; and a master may hypothecate either ship or goods for relief, when in distress at sea; for he represents the traders as well as owners.

HYPOTHENUSE, in geometry, the longest side of a right-angled triangle; or it is that side which subtends the right angle. Euclid, lib. I. proposition XLVII. demonstrates, that in every rectilinear right-angled triangle, the square of the hypothenuse is equal to the squares of both the other sides. This celebrated problem was discovered by Pythagoras, who is said to have sacrificed a hecatomb to the Muses, in gratitude for the discovery.

HYPOTHESIS, in general, denotes something supposed to be true, or taken for granted, in order to prove or illustrate a point in question.

HYSTRIX, *porcupine*, a genus of quadrupeds, of the order glires. The generic character is, front teeth two, both in the upper and under jaw, obliquely cut; grinders eight; body covered with spines intermixed with hairs; four toes on the fore-feet; five on the hind. There are five species, viz.

1. The common porcupine. The general length of the porcupine is about two feet from head to tail, and that of the tail about four inches. The upper parts of the animal are covered with long, hard, and sharp quills; those towards the middle and hind part of the body being longer than the rest, and measuring from nine or ten to twelve or fifteen inches in length; they are very sharp-pointed, and are variegated with several alternate black and white rings: the root, or point of attachment, is small; the head, belly, and legs, are covered with strong dusky bristles, intermixed with softer hairs: on the top of the head the hairs are very long, and curved backwards in the manner of a ruff or crest.

This animal is a native of Africa, India, and the Indian islands; it is also found in some of the warmer parts of Europe, and is said to be not very uncommon in Italy.

The porcupine feeds principally on roots, fruits, barks, and other vegetable substances: it inhabits holes or subterraneous retreats, which it is said to form into several compartments or divisions, leaving only a single hole or entrance. It sleeps much by day, and makes its excursions for food during the night. The female produces two young at a birth, and these, if taken early, are said to be easily tamed.

2. *Hystrix prehensilis*, is an American species, and is found in many of the hotter parts of that continent; particularly in Brazil, where it inhabits woods, and climbs trees; clinging occasionally to the branches by its

tail, in the manner of some of the opossums and monkies. It is said to feed not only on fruits of various kinds, but also on birds. It sleeps during the greater part of the day, concealing itself in the hollows of trees, or beneath their roots. Its voice, according to Marcgrave, resembles the grunting of a pig. Its general length is about a foot, and the tail about eighteen inches. The whole animal, except on the belly and insides of the limbs, is covered with short, strong, and very sharp spines.

3. *Hystrix Mexicana.* The Mexican porcupine, which is placed as a variety of the hystrix prehensilis in the Gmelinian edition of the Systema Naturæ, seems to be justly considered as a distinct species. It is as large, as a middle-sized dog, and is of a dusky brown colour, with very long bristles intermixed with the fur. This animal inhabits the hilly parts of Mexico, residing in woods, and feeding, like the former, on fruits, &c. It is said to be easily tamed.

4. *Hystrix macroura.* The iridescent porcupine is an animal of a very extraordinary appearance. It is of a very thick form, and is coated with short, stiff bristles, which, according to the different directions of the light, exhibit changeable colours, appearing either of a gilded green, or of a reddish tinge. If we except the gilded, or cape mole, it seems to be almost the only quadruped yet known with changeable-coloured hair.

5. *Hystrix fasciculata* is a native of Malacca. It differs from the common porcupine in several particulars, and especially in the form and length of its tail, which is naked, scaly, about a third of the length of the body, and terminated by a tuft of long flat hairs, or rather small white laminæ, resembling strips of parchment. The body measures fifteen or sixteen inches, and is consequently less than that of the European porcupine.

6. *Hystrix dorsata* is a native of the northern parts of America, and is not uncommon in Canada. It is a short thick-bodied animal, approaching somewhat to the form of a beaver, and is remarkable for the length and fulness of its fur, which is soft, of a dusky brown colour, and intermixed with longer and coarser hairs with whitish tips. It is said to feed principally on the bark of the juniper tree. It drinks by lapping, in the manner of a dog. It resides in holes under the roots of trees, on which, like some others of this genus, it often climbs, and is thus killed by the American Indians, who consider it as a useful article of food; they also use the quills by way of fringes, and for the purpose of ornamenting their boxes, &c

I & J.

I, the ninth letter of the alphabet, used as a numeral, signifies no more than one, and stands for so many units as it is repeated times: thus, I, one; II, two; III, three, &c. and when put before a higher numeral, it subtracts itself, as IV, four; IX, nine, &c. but when set after it, so many are added to the higher numeral, as there are I's added; thus VI is 5+1, or six; VII, 5+2, or seven; VIII, 5+3, or eight. The ancient Romans likewise used IƆ for 500, CIƆ for 1000, IƆƆ for 5000, CCIƆƆ, for 10,000, IƆƆƆ for 50,000, and CCCIƆƆƆ for 100,000. Farther than this, as Pliny observes, they did not go in their notation; but when necessary, repeated the last number, as CCCIƆƆƆ, CCCIƆƆƆ for 200,000: CCCIƆƆƆ, CCCIƆƆƆ, CCCIƆƆƆ for 300,000; and so on.

Besides the vowel, there is the jod consonant; which, because of its different pronunciation, has likewise a different form, thus, J. j. In English it has the soft sound of *g*, nor is used but when *g* soft is required before vowels, where *g* is usually hard: thus we say *jack*, *jet*, *join*, &c. instead of *gack*, *get*, *goin*, &c. which would be contrary to the genius of the English language.

JACK, in mechanics, an instrument of common use for raising heavy timber, or very great weights of any kind. The common kitchen jack is a compound engine, where the weight is the power applied to overcome the friction of the parts, and the weight with which the spit is charged; and a steady and uniform motion is obtained by means of the fly.

Jack, in naval affairs, a sort of flag, or colours, displayed from a staff erected on the outer end of a ship's bowsprit. In the British navy the jack is a small union flag; but in merchant ships the union is bordered with red.

Jack, *smoke.* See Smoke Jack.

Jack *in the box*, a large wooden male screw, turning in a female one, which forms the upper part of a strong wooden box, shaped like a frustrum of a pyramid. It is used by means of levers passing through holes in it, as a press in packing, and for other purposes.

Jack-*flag*, in a ship, that hoisted up at the sprit-sail top-mast head.

JACKALL. See Canis.

JACOBUS, an ancient gold coin worth twenty-five shillings.

JACQUINIA, a genus of the monogynia order, in the hexandria class of plants; and in the natural method ranking with those of which the order is doubtful. The corolla is decemfid; the stamina inserted into the receptacle; the berry monospermous. There are four species, shrubs of South America.

JADE. See Nephrite.

JALAP is the root of the convolvulus jalappa. It derives its name from Xalapa, a town of Mexico, in the environs of which it grows plentifully. It is also found among the sands of Vera Cruz. This plant resembles in appearance the convolvulus of our hedges.

By M. Henry's analysis, the constituents of three different varieties of this root are,

	Jal. leger.	Jal. semi	Jal. pique
Resin,	60	48	72
Extract,	75	140	125
Starch,	95	102	103
Woody fibre,	270	210	200
	500	500	500

IAMBIC, in ancient poetry, a sort of verse so called from its consisting, either wholly or in great part, of iambuses. The word is applied also to a particular kind of Latin verse, of

which the simple foot consists of a short and long syllable.

JAPANNING is properly the art of varnishing and painting ornaments on wood, in the same manner as is done by the natives of Japan in the East Indies.

The substances which admit of being japanned are almost every kind that are dry and rigid, or not too flexible; as wood, metals, leather, and paper, prepared for the purpose. Wood and metals do not require any other preparation but to have their surfaces perfectly even and clean; but leather should be securely strained, either on frames or on boards; as its bending, or forming folds, would otherwise crack and force off the coats of varnish. Paper should be treated in the same manner, and have a previous strong coat of some kind of size; but it is rarely made the subject of japanning till it is converted into paper mache, or wrought by other means into such form, that its original state, particularly with respect to flexibility, is changed.

One principal variation from the method formerly used in japanning is, the omitting any priming, or undercoat, on the work to be japanned. In the older practice, such a priming was always used; the use of which was to save in the quantity of varnish, by filling up the inequalities in the surface of the substance to be varnished. But there is a great inconvenience arising from the use of it, that the Japan coats are constantly liable to be cracked, and peeled off, by any violence, and will not endure near so long as the articles which are japanned without any such priming.

Of the nature of Japan grounds.—When a priming is used, the work should first be prepared by being well smoothed with fish-skin or glass-paper, and being made thoroughly clean, should be brushed over once or twice with hot size, diluted with two-thirds water, if it is of the common strength. The priming should then be laid on as even as possible, and should be formed of a size, of a consistency between the common kind and glue, mixed with as much whiting as will give it a sufficient body of colour to hide the surface of whatever it is laid upon, but not more. This must be repeated till the inequalities are completely filled up, and then the work must be cleaned off with Dutch rushes, and polished with a wet rag.

When wood or leather is to be japanned, and no priming is used, the best preparation is to lay two or three coats of coarse varnish, composed in the following manner. Take of rectified spirit of wine one pint, and of coarse seed-lac and resin each two ounces; dissolve the seed-lac and resin in the spirit, and then strain off the varnish. This varnish, as well as all others formed of spirit of wine, must be laid on in a warm place; and if it can be conveniently managed, the piece of work to be varnished should be made warm likewise; and for the same reason, all dampness should be avoided; for either cold or moisture chills this kind of varnish, and prevents its taking proper hold of the substance on which it is laid.

When the work is so prepared, or by the priming with the composition of size and whiting above described, the proper japan ground must be laid on, which is much the best formed of shell-lac varnish, and the colour desired, except white, which requires a peculiar treatment; and if brightness is wanted, then also other means must be pursued. The colours used with the shell-lac varnish may be any pigments whatever, which give the tint of the ground desired. As metals never require to be under-coated with whiting, they may be treated in the same manner as wood or leather.

Method of painting Japan work.—Japan work ought properly to be painted with colours in varnish; though, for the greater dispatch, and in some very nice work in small, for the freer use of the pencil, the colours are sometimes tempered in oil; which should previously have a fourth part of its weight of gum animi dissolved in it; or in default of that, gum sandarach, or gum mastich. When the oil is thus used, it should be well diluted with oil of turpentine, that the colours may lie more evenly and thin; by which means fewer of the polishing or upper coats of varnish become necessary. When a sufficient number of coats is thus laid on, the work is fit to be polished; which must be done, in common cases, by rubbing it with a rag dipped in tripoli, or rottenstone, finely powdered; but, towards the end of the rubbing, a little oil of any kind should be used along with the powder; and when the work appears sufficiently bright and glossy, it should be well rubbed with the oil alone, to clean it from the powder, and give it a still brighter lustre.

JARGON. See Zircon.

JASIONE, a genus of the monogamia order, in the syngenesia class of plants, and in the natural method ranking under the 49th order, campanaceæ. There are four species, shrubs of the West Indies.

JASMINUM, *Jasmine*, or Jessamine-tree, a genus of the monogynia order, in the diandria class of plants, and in the natural method ranking under the 44th order, sepiariæ. The corolla is salver-shaped, the berry dicoccous; the seeds arillated, the antheræ within the tube. There are 17 species.

JASPER. A sub-species of the rhomboidal quartz of Professor Jameson. He enumerates five kinds: Egyptian jasper, striped, porcelain, common, and agate jasper.

1. *Egyptian jasper*, of which there are red and brown. The first is flesh-red, blood-red, yellow, and brown, in ring-shaped delineations. In roundish pieces. It is found imbedded in red clay-ironstone at Baden, and is cut into ornaments.

The *brown* has its various shades of colour disposed in concentric stripes, alternating with black stripes. In spheroidal masses. Lustre glimmering. Fracture conchoidal. Feebly translucent on the edges. As hard as hornstone. Specific gravity 2.6. It is infusible. It occurs loose in the sands of Egypt. It is cut into ornaments.

2. *Striped jasper.* Colours, grey, green, yellow, red, arranged in stripes, in flamed, or spotted delineations. Massive in whole beds. Dull. Fracture conchoidal. Opaque. Less hard than Egyptian jasper. Rather easily frangible. Specific gravity 2.5. It occurs in secondary clay-porphyry in the Pentland-hills, and near Friburg in Saxony. It receives a fine polish.

3. *Porcelain jasper.* Colours grey, blue, yellow, generally of one colour, or with clouded delineations. Massive, and cracked in all directions. Lustre glistening. Fracture con-

choidal. Opaque. Easily frangible, and not very hard. Specific gravity, 2.5. Fuses into a white or grey glass. It is always found along with burnt clay and earth slags. It is found on the coast of Fifeshire, in Shropshire, and Warwickshire, and some parts of Germany, where immense beds of coal appear.

4. *Common jasper.* Colours red and brown. Massive. Lustre, from shining to dull. Fracture conchoidal. Opaque. Hard in a low degree. Rather easily frangible. Specific gravity 2.6. Infusible before the blowpipe, becoming at last white. It occurs principally in veins as a constituent of agate. It is found in the Pentland-hills, and in trap and transition rocks in Aryshire and Dumfries-shire. It receives a good polish.

5. *Agate jasper.* Colours yellowish-white and reddish-white. Massive. Dull. Fracture flat conchoidal. Opaque. Hard in a low degree. It occurs in layers in agate balls, in many places.

JATROPHA, the *cassada plant*, a genus of the monodelphia order, in the monœcia class of plants, and in the natural method ranking under the 38th order, tricocca. There are nine species, of which the most remarkable are: 1. The curcas or English physic nut. 2. The gossypifolia, cotton-leaved jatropha. 3. The multifida, or French physic nut. 4. The manihot, or bitter cassada, has palmated leaves; the lobes lanceolate, very entire, and polished. 5. The janipha, or sweet cassada, has palmated leaves, with lobes very entire; the intermediate leaves lobed with a sinus on both sides. 6. The elastica, or hevea guianensis, with ternate leaves elliptic, very entire, hoary underneath, and longly petiolated. See CAOUTCHOUC.

The root of bitter cassada has no fibrous or woody filaments in the heart, and neither boils nor roasts soft. The sweet cassada has all the opposite qualities. The bitter, however, may be deprived of its noxious qualities (which reside in the juice) by heat. Cassada bread, therefore, is made of both, thus: the roots are washed and scraped clean, then grated into a tub; after this, they are put into a hair bag, and strongly pressed, to squeeze out the juice, and the meal is dried in a hot stone bason over the fire. Cassada roots yield a great quantity of starch, which the Brazilians export in little lumps under the name of tapioca.

JAY. See CORVUS.

IBEX, in zoology. See CAPRA.

IBIS. See TANTALUS.

ICE. See CONGELATION.

ICE-*house*, a building contrived to preserve ice for the use of a family in the summer season. It is generally sunk some feet in the ground in a very shady situation, and covered with thatch.

ICELAND-*agate*, a precious stone met with in the islands of Iceland and Ascension, employed by the jewellers as an agate, though too soft for the purpose. It is supposed to be a volcanic product; being solid, black, and of a glassy texture. When held between the eye and the light, it is semitransparent, and greenish, like the glass bottles which contain much iron. In the islands which produce it, such large pieces are met with that they cannot be equalled in any glass-house.

ICHNEUMON *fly*, the name of a genus of flies of the hymenoptera order. The generic character is, mouth with jaws, without tongue: antennæ with more than thirty joints; abdomen in most species footstalked; piercer exserted, with a cylindric bivalve sheath. The animals of this genus provide for the support of their offspring in a manner highly extraordinary, depositing their eggs in the bodies of other living insects, and generally in those of caterpillars. These eggs in a few days hatch, and the young larvæ, which resemble minute white maggots, nourish themselves with the juices of the unfortunate animal, which however continues to move about and feed till near the time of its change to a chrysalis, when the young brood of ichneumon-larvæ creep out by perforating the skin in various places, and each spinning itself up in a small oval silken case, changes into a chrysalis, the whole number forming a groupe on the shrivelled body of the caterpillar which had afforded them nourishment; and after a certain period emerge in the state of complete ichneumons.

ICHNOGRAPHY, in perspective, the view of any thing cut off by a plane parallel to the horizon, just at the base of it.

ICHTHYOCOLLA. See ACCIPENSER and GELATINA.

ICHTHYOLITHUS, in natural history, the body or parts of a fish changed into a fossil substance. Four species are enumerated. They are seldom found whole, but in different parts, as the head, gill-covers, and other bones, fins, tails, tendrils, or scales, in a grey slaty swine-stone, or impressed on shistose marble, and sometimes penetrated with bitumen.

ICHTHYOLOGY, *ιχθυολογια*, the science of fishes, or that branch of zoology which treats of fishes. See PISCES.

ICOSAHEDRON, in geometry, a regular solid, consisting of twenty triangular pyramids, whose vertices meet in the centre of a sphere, supposed to circumscribe it; and, therefore, have their height and bases equal; wherefore the solidity of one of those pyramids multiplied by twenty, the number of bases, gives the solid content of the icosahedron.

ICOSANDRIA, from *εικοσι* "twenty," and *ανηρ*, "a man or husband;" the name of the 12th class in Linnæus's sexual method, consisting of plants with hermaphrodite flowers, which are furnished with twenty or more stamina, that are inserted into the inner side of the calyx or petals. See BOTANY.

IDEAOLOGY. The philosophy of the human mind. We are conscious of our own existence; and in this consciousness we perceive a certain variety or successive change, which we distinguish by the name of thought. It seems as if it would be a vain attempt to investigate by what physical operations the proceedings of the mind may be caused, supported, or governed. The primary objects of thought are derived from our sensations or perceptions. We can form no conception of any subject of thought which shall not be referable to the senses. During the actual time of sensation we suppose ourselves to be operated upon, by some beings or objects which constitute no part of ourselves; and we do not hesitate to infer from those sensations, that an external universe does actually subsist. Berkeley, Hume, and others, have made this a subject of question; and it must be confessed, that we have no absolute proof respecting it. From the certainty, however that we ourselves do not cause the changes

which produce sensation in us, we are irresistibly impelled to an affirmative decision of this question.

In many instances, the sensations we experience afford some resemblance of the objects which cause them, as in the figures of bodies; but in others, it is probable that no such resemblance exists, as in colours, sounds, &c. A distinction has therefore very properly been made, between that which is perceived, and the cause of the perception: and, moreover, as we find that effects, similar to our antecedent perceptions, may and do take place, though the organs of sense are not then acted upon, we make a further distinction between these last, and the perceptions themselves. We call them ideas. They not only resemble the perceptions, as individually considered, but likewise make their appearance in the same arrangement or order of recurrence. We think we perform a positive act, in many instances, in bringing them forward, which we call an act of the memory, or recollection; and their concomitant appearance, or the succession of ideas by recollection, in the similarity or the order of the sensations, has been called the association of ideas. The same term is likewise applied, when we speak of the recurrence, in idea, of an entire contemporaneous sensation, in consequence of part of it being brought forward in the memory.

Much discussion has taken place among philosophers, respecting the origin and nature of our ideas; in which it must be confessed that a mis-application of terms, a confusion of intellectual research, with an admixture of theological notions, and several other causes, have united to render a plain subject considerably obscure, even in the hands of men of much talent and acuteness.

IDENTITY, denotes that by which a thing is itself, and not any thing else.

IDIOM, among grammarians, properly signifies the peculiar genius of each language, but is often used in a synonymous sense with dialect.

IDIOSYNCRASY, among physcians, denotes a peculiar temperament of body, whereby it is rendered more liable to certain disorders, than persons of a different constitution usually are.

IDIOTS, in law. An idiot is a fool or madman from his nativity. According to the statute 17 Edward II. c. 9, the king shall have the custody of the lands of natural fools, taking the profits of them without waste or destruction, and shall find them necessaries. And, after the death of them, he shall render it to the right heir.

But it seldom happens, that a jury finds a man an idiot from his nativity, but only *non compos mentis*, from some particular time; in which case, he comes under the denomination of a lunatic, of whose lands the king shall not have the profit, but is accountable for the same to the lunatic when he comes to his right mind, or to his executors or administrators.

An idiot, or person *non compos*, may inherit, and purchase, and if he marry and die, his wife shall be endowed. It is a general rule, that idiots and lunatics, being incapable of judging between good and evil, are punishable by no criminal prosecution whatsoever. Acts solemnly acknowledged by them in a court of record, as fines and recoveries, and the uses declared on them, are good, and cannot be avoided by themselves or representatives. But during their lunacy they are incapable of making any will or testament, as are also persons grown childish from extreme old age. When an idiot sues, or defends, he must appear; but a lunatic shall appear by guardian or by attorney.

JELLY, in chemistry. If we press out the juice of ripe blackberries, currants, and many other fruits, and allow it to remain for some time in a state of rest, it partly coagulates into a tremulous soft substance, well known by the name of jelly. If we pour off the uncoagulated parts, and wash the coagulum with a small quantity of water, we obtain jelly approaching to a state of purity.

In this state it is nearly colourless, unless tinged by the peculiar colouring matter of the fruit. It is scarcely soluble in cold water, but very soluble in hot water; and when the solution cools, it again coagulates into the form of a jelly. When long boiled, it loses the property of gelatinizing by cooling, and becomes analogous to mucilage. This is the reason that in making currant-jelly, or any other jelly, when the quantity of sugar added is not sufficient to absorb all the watery parts of the fruit, and consequently it is necessary to concentrate the liquid by long boiling, the mixture often loses the property of coagulating, and the jelly, of course, is spoiled.

JESUITS, in church history, or the society of Jesus, a celebrated religious order in the Romish church, founded by Ignatius Loyoly, a Spaniard, who in the year 1738, assembled ten of his companions at Rome, and proposed to form a new order, when it was agreed to add to the three ordinary vows of chastity, poverty, and obedience, a fourth, which was to go wherever the Pope should command, to make converts. They were admitted on their own terms; but the order was abolished, on account of the enormities committed by them, in 1773.

JESUIT'S-*bark*. See CINCHONA and PHARMACY.

JET. See COAL.

JET D'EAU. See HYDRAULICS.

JEWS, in church history, the descendants of Judah, the son of Jacob, and of the Israelites, commonly denominated the Twelve Tribes of Israel. This name was first given to those Jews who returned from the captivity of Babylon, because the tribe of Judah made the most conspicuous figure among them.

The following is a summary of their religious creed 1. That God is the creator and active supporter of all things. 2. That God is one, and eternally unchangeable. 3. That God is incorporeal, and cannot have any material properties. 4. That God shall eternally subsist. 5. That God alone above is to be worshipped. 6. That whatever has been taught by the prophets is true. 7. That Moses is the head and father of all contemporary doctors, and of all those who lived before, or shall live after him. 8 That the law was given by Moses. 9. That the law shall always exist, and never be altered. 10. That God knows all the thoughts and actions of men. 11. That God will reward the observance and punish the breach of his laws. 12. The Messiah is to come, though he tarry a

long time. 13. That there shall be a resurrection of the dead when God shall think fit. In England, in former times, the Jews and all their goods belonged to the chief lord where they lived. By stat. Edward I. the Jews, to the number of 15,000, were banished out of England; and never returned till Oliver Cromwell readmitted them. Whenever any Jew shall present himself to take the oath of abjuration in pursuance of the 10 Geo. III. c. 19, the words "upon the true faith of a Christian" shall be omitted. If Jewish parents refuse to allow their protestant children a maintenance suitable to their fortune, the lord chancellor, upon complaint, may make such order therein as he may think proper.

IGNIS FATUUS. A luminous appearance or flame, frequently seen in the night in different country places, and called in England *Jack with a lantern, or Will with the wisp.* It seems to be mostly occasioned by the extrication of phosphorus from rotting leaves and other vegetable matters. It is probable, that the motionless ignes fatui of Italy which are seen nightly on the same spot, are produced by the slow combustion of sulphur, emitted through clefts and apertures in the soil of that volcanic country.

JIB, the foremost sail of a ship, being a large stay-sail extended from the outer end of the bowsprit prolonged by the jib-boom, towards the fore-top-mast-head.

ILEX, *the holm or holly tree,* a genus of the tetragynia order, in the tetrandria class of plants, and in the natural method ranking under the 43d order, dumosæ. The calyx is quadridentated; the corolla rotaceous; there is no style: the berry is monospermous. There are sixteen species of this genus; but the most remarkable is the aquifolium, or common holly. Sheep in the winter are fed with croppings of holly. Birds eat the berries. The bark fermented, and afterwards washed from the woody fibres, makes the common birdlime. The plant makes an impenetrable fence, and bears cropping; however it is not found in all respects to answer for this purpose equally well with the hawthorn.

The common holly affords a most striking example of the wise intention of the great Author of nature, in furnishing some plants with spines and prickles, which disappear after they have acquired a degree of height and strength sufficient to protect them from being eaten by cattle. This is finely described by Southey in the following lines.

O reader! hast thou ever stood to see
The holly-tree?
The eye that contemplates it well perceives
Its glossy leaves,
Ordered by an Intelligence so wise,
As might confound the atheist's sophistries.

Below, a circling fence, its leaves are seen,
Wrinkled and keen:
No grazing cattle, through their prickly round,
Can reach to wound:
But, as they grow *where nothing is to fear,*
Smooth and *unarmed* the pointless leaves appear.

ILLUMINATING, a kind of miniature-painting, anciently much practised for illustrating and adorning books. Besides the writers of books, there were artists whose profession was to ornament and paint manuscripts, who were called illuminators: the writers of books first finished their part, and the illuminators embellished them with ornamented letters and paintings. We frequently find blanks left in manuscripts for the illuminators which were never filled up. Some of the ancient manuscripts are gilt and burnished in a style superior to later times. Their colours were excellent, and their skill in preparing them must have been very great.

IMAGE. See Optics.

IMAGINATION, a power or faculty of the mind, whereby it conceives and forms ideas of things communicated to it by the outward organs of sense.

IMBRICATED, among botanists, an appellation given to such leaves of plants, as are placed over one another like the tiles of a house.

IMITATIVE, in music, a term applicable to that music which is composed in imitation of the effects of some of the operations of nature, art, or human passion, as the rolling of thunder, swiftness of lightning, agitation of the sea, bellowing of the winds or waves, &c.

IMMERSION, that act by which any thing is plunged into water, or other fluid. See Fluid.

Immersion, in astronomy, is when a star or planet is so near the sun with regard to our observations, that we cannot see it; being as it were enveloped and hidden in the rays of that luminary. It also denotes the beginning of an eclipse of the moon, or that moment when the moon begins to be darkened, and to enter into the shadow of the earth; and the same term is also used with regard to an eclipse of the sun, when the disk of the moon begins to cover it. In this sense emersion stands opposed to immersion, and signifies the moment wherein the moon begins to come out of the shadow of the earth, or the sun begins to show the parts of his disk which were hid before.

IMPARLANCE, in law, a petition in court for a day to consider or advise what answer the defendant shall make to the plaintiff's action, and is the continuance of the cause till another day, or a longer time given by the court.

An imparlance is general or special: general is when it is entered in general terms, without any special clause therein; special is where the defendant desires a further day to answer.

IMPEACHMENT, is the accusation and prosecution of a person in parliament, for treason or other crime and misdemeanor. An impeachment before the lords by the commons of Great Britain, is a presentment to the most high and supreme court of criminal jurisdiction, by the most solemn, grand inquest of the whole kingdom. The articles of impeachment are a kind of bill of indictment, found by the house of commons, and afterwards tried by the lords. By stat. 12 and 13 W. c. 2. no pardon under the great seal shall be pleadable to an impeachment by the commons in parliament.

In the case of Warren Hastings, in the year 1791, it was solemnly determined that impeachments do not abate by a dissolution of parliament.

Impeachment *of waste,* signifies a restraint from committing of waste upon lands and tenements; and therefore he that has a lease without impeachment of waste, has by that a property or interest given him in the houses and trees, and may make waste in them without being impeached for it.

IMPEDIMENTS *in law.* Persons under impediments are those within age, under cover-

ture, *non compos mentis*, in prison, or beyond seas, who by a saving in our laws, have time to claim and prosecute the right, after the impediments removed, in case of fines levied, &c.

IMPENETRABILITY. See DIVISIBILITY.

IMPERATIVE, one of the moods of a verb, used when we would command, entreat, or advise: thus, *go, read, take pity, be advised,* are imperatives in our language.

IMPERFECT, something that is defective, or that wants some of the properties found in other beings of the same kind: thus mosses are called imperfect plants, because almost all the parts of fructification are wanting in them; and for the like reason is the appellation imperfect given to the fungi and submarine plants.

IMPERFECT *numbers,* such whose aliquot parts taken together do either exceed, or fall short of that whole number of which they are parts: they are either abundant or deficient.

IMPERSONAL *verb,* in grammar, a verb to which the nominative of any certain person cannot be prefixed; or, as others define it, a verb destitute of the two first and primary persons.

IMPETIGENES, in medicine, descriptive of those disorders which, from a general bad habit, manifest themselves principally by disfiguring the skin and external parts of the body.

IMPETUS, in mechanics, the force with which one body impels or strikes another.

IMPLEAD, to sue or prosecute by course of law.

IMPLICATION, in law, is where the law implies something that is not declared between parties in their deeds and agreements, and when our law gives any thing to a man, it gives by implication whatever is necessary for enjoying it.

IMPORTATION, the act of bringing goods into a country from foreign parts. It has generally been considered, that for any country to carry on a profitable trade, it is necessary that the value of the goods sent out of it should be greater than that of the articles imported: this, however, is a very erroneous axiom, unless it is understood with great limitations. All articles of merchandize, imported merely for re-exportation, and also such as are used or worked up in our own manufactures, are far from being hurtful to our commerce; and may even, in many respects, be deemed of equal profit with our own native commodities. It is therefore an excess of such importations alone as are either for mere luxury or mere necessity, or for both together, which is disadvantageous to the country.

IMPOSTS, in architecture, the capitals of pillars, or pilasters, which support arches. An impost sometimes called chaptrel, is a sort of a plinth, or a little cornice, which crowns a pier, and supports the first stone whence an arch or vault commences.

IMPOTENCE, in the ecclesiastical law, is an inability of generation, or propagating the species, and forms a cause of divorce a vinculo matrimonii, as being merely void, and requiring only a sentence declaratory of its being so.

IMPRESSING *men.* The power of impressing seamen for the sea-service, by the King's commission, has been a matter of some dispute, and submitted to with great reluctance, though it has very clearly and learnedly been shown by Sir Michael Forster, that the practice of impressing seamen for the sea-service, and granting power to the Admiralty for that purpose, is of a very ancient date, and has been continued by a series of precedents, to the present time, whence it has been held to be a part of the common law; and though no statute has expressly declared this power to be in the crown, many of them very strongly imply it. Landmen, entering into the merchant service, and apprentices, are exempt for two years from the impress, and all apprentices to the sea-service under eighteen.

IMPRISONMENT, is the restraint of a man's liberty under the custody of another, and extends not only to a gaol, but a house, stocks, or where a man is held in the street, or any other place; for in all these cases, the party so restrained is said to be a prisoner.

None shall be imprisoned but by the lawful judgment of his peers, or by the law of the land. Magna Charta.

IMPRISONMENT, *false.* To constitute the injury of false imprisonment, two points are necessary: the detention of the person, and the unlawfulness of such detention.

IMPROPRIATION, is properly so called when a benefice ecclesiastical is in the hands of a layman; and appropriation when in the hands of a bishop, college, or religious house, though sometimes these terms are confounded. It is said there are 3845 impropriations in England.

IMPULSE, or IMPULSIVE FORCE, the same with impetus. See MECHANICS.

INARCHING, in gardening. See GRAFTING.

INCH, a well-known measure of length, being the twelfth part of a foot, and equal to three barley corns in length.

INCIDENCE, in mechanics, denotes the direction in which one body strikes on another See MECHANICS and OPTICS.

INCLINATION, is a word frequently used by mathematicians, and signifies the mutual approach, tendency, or leaning, of two lines or two planes towards each other, so as to make an angle.

INCLINED *plane,* in mechanics, one that makes an oblique angle with the horizon. See MECHANICS.

INCLOSURES. Any person who shall wilfully or maliciously destroy or damage any fence made for inclosing any common waste or other lands, in pursuance of any act of parliament, shall be transported for seven years.

INCOMBUSTIBLE. See COMBUSTION.

INCOME *tax,* a direct contribution of a certain proportion of the annual gains of individuals for the public service, which has become an important branch of the revenue of Great Britain. An attempt was made in 1702 to levy a tax of this description; but it proved unproductive, and was discontinued. Towards the end of the year 1798, Mr. Pitt proposed, in lieu of the additional assessed taxes, a general tax on income. The act was passed 9th January, 1799; and the duties imposed by it were, ten per cent. on all incomes of 200*l.* per annum and upwards, and lesser proportions on incomes between that amount and 60*l.* per annum, which paid ten shillings per annum: incomes below 60*l.* a year were wholly exempt. The great object of this tax was, to raise a considerable proportion of the public supplies within the

year, and to liquidate within a short time what might be further raised by loan; but it being a tax which from its commencement had been very unpopular, it was repealed in April, 1802, and the charges upon it transferred to the Consolidated Fund.

In 1803 the income tax was revived, with some alterations in the mode of collecting it, under the title of the property tax: the rate at which it was now imposed was 5 per cent. on all incomes above 150*l.* per annum, and lesser proportions on incomes between that amount and 60*l.* per annum. In 1805 it was increased to 6¼ per cent.; and in 1806 it was raised to the original rate at which it had been imposed, or 10 per cent., while the scale of lesser rates was made to comprehend all incomes amounting to 50*l.* per annum. By this means, and by deducting the tax on the dividends of the public funds at the bank, and abolishing most of the former abatements and exemptions, the sum raised by it has been considerably augmented, the estimated produce being as follows:

1804 at 1*s.* in the pound............	£4,650,000
1805 at 1*s.* 3*d.* ditto..................	5,937,500
1806 at 2*s.*........ditto..................	11,500,000

An income tax, if it could be so regulated as to bear a just proportion to the different modes in which the incomes of individuals arise, and did not extend to such amounts of income as are absolutely necessary for subsistence, would become the most equitable, as well as the most productive mode of taxation.

INCOMMENSURABLE, a term in geometry, used where two lines, when compared to each other, have no common measure, how small soever, that will exactly measure them both. And in general two quantities are said to be incommensurable, when no third quantity can be found that is an aliquot part of both.

INCOMPLETE, in botany, a term used to denote the sixteenth class of the Linnæan "methodus calycina," consisting of plants whose flowers want either the calyx or petals.

INCORPORATION, *power of.* To the erection of any corporation the king's consent is necessary, either impliedly or expressly given. The methods by which the king's consent is expressly given are either by act of parliament or charter.

INCREMENT, is the small increase of a variable quantity. Sir Isaac Newton calls these increases "moments," and observes, that they are proportional to the velocity or rate of increase of the flowing or variable quantities, in an indefinitely small time.

INCUBUS, or **NIGHT-MARE**, a disease which consists in a spasmodic contraction of the muscles of the breast, usually happening in the night, and attended with very painful difficulty of respiration and great anxiety; most frequently caused by eating heavy suppers.

INDEFINITE, or **INDETERMINATE**, that which has no certain bounds; or to which the human mind cannot affix any.

INDEFINITE is also used in the schools to signify a thing that has but one extreme; for instance, a line drawn from any point and extended infinitely.

INDEMNITY, in law, the saving harmless; or, a writing to secure one from all damage and danger that may ensue from any act. An indemnity in regard to estates is called a warranty.

INDENTED, in heraldry, is when the outline of an ordinary is notched like the teeth of a saw.

INDENTED *line*, in fortification, the same with what the French engineers call redent; being a trench and parapet running out and in, and much used in irregular fortification.

INDENTURE, is a writing containing a conveyance between two or more, indented or cut unevenly, or in and out, on the top or side, answerable to another writing that likewise comprehends the same words. Formerly when deeds were more concise than at present, it was usual to write both parts on the same piece of parchment, with some words or letters written between them, through which the parchment was cut, either in a straight or indented line, in such a manner as to leave half the word on one part, and half on the other; and this custom is still preserved in making out the indentures of a fine.

But at last, indenting only has come into use without cutting through any letters at all; and it seems at present to serve for little other purpose than to give name to the species of the deed.

INDEPENDENTS, a sect of protestants in England and Holland, so called from their independency on other churches, and their maintaining that each church or congregation has sufficient power to act and perform every thing relating to religious government within itself, and is no way subject or accountable to other churches or their deputies.

INDEX, in arithmetic and algebra, shows to what power any quantity is involved, and is otherwise called *exponent.*

INDEX *of a logarithm*, that which shows of how many places the absolute number, belonging to a logarithm, doth consist; and of what nature it is, whether an integer or fraction.

INDICATIVE, in grammar, the first mood or manner of conjugating a verb, by which we simply affirm, deny, or ask something; as, *amant*, they love; *non amant*, they do not love: *amantne*, do they lo

INDICTION, in chronology, a cycle of 15 years. The Roman or papal indiction, which is that used in the pope's bulls, begins on the 1st of January; and by it the popes have dated their acts ever since Charlemagne made them sovereigns. But besides this, there are other two kinds of indiction, viz. that of Constantinople beginning on the first of September; and the imperial or Cæsarian indiction, which commenced on the 14th of September.

INDICTMENT, is a written accusation of one or more persons of a crime or misdemeanor, preferred to, and presented on oath by, a grand jury.

An indictment may be found on the oath of one witness only, unless it is for high treason, which requires two witnesses; and unless in any instance it is otherwise specially directed by acts of parliament.

The sheriff of every county is bound to return to every session of the peace, and every commission of oyer and terminer, and of general gaol-delivery, 24 good and lawful men, of the county, some out of every hundred, to inquire, present, do, and execute, all those things which on the part of our lord the [illegible]g, shall then and

there be commanded therein. As many as appear upon this pannel are sworn of the grand jury, to the amount of twelve at the least, and not more than twenty-three, that twelve may be a majority. This grand jury is previously instructed in the articles of their inquiry, by a charge from the judge on the bench. They then withdraw from court to sit and receive indictments preferred to them in the name of the king, but at the suit of any private prosecutor; and they are only to hear evidence on behalf of the prosecution.

They may not find part of an indictment true and part false; but must either find a true bill or ignoramus for the whole.

All capital crimes whatever, and all kinds of inferior crimes which are of a public nature, may be indicted, but no injuries of a private nature, unless they in some degree concern the king. And generally where a statute prohibits a matter of public grievance, or commands a matter of public convenience, every disobedience of such statute is punishable, not only at the suit of the party grieved, but also by way of indictment. Yet if the party offending has been fined in an action brought by the party, such fine is a good bar to the indictment.

If several offenders commit the same offence, they may be joined in one indictment; as if several commit a robbery, or burglary, or murder.

No indictment for high treason, or misprision thereof (except indictments for counterfeiting the king's coin, seal, sign, or signet,) nor any process or return thereupon, shall be quashed for mis-reciting, mis-spelling, false or improper Latin, &c. unless exception concerning the same is taken, and made in the respective court where the trial shall be, by the prisoner or his counsel assigned, before any evidence given in open court on such indictment.

No indictment can be good without expressly shewing some place wherein the offence was committed, which must appear to have been within the jurisdiction of the court. There are several emphatical words which the law has appropriated for the description of an offence, which no circumlocution will supply: as *feloniously*, in the indictment of any felony; *burglariously*, in an indictment of burglary, and the like. An indictment on the black act for shooting at any person must charge that the offence was done wilfully and maliciously. It is enacted, that no clerk of assize, clerk of the peace, or other person, shall take any money of any person bound over to give evidence against a traitor or felon for the discharge of his recognizance, nor take more than 2*s.* for drawing any bill of indictment against any such felon, on pain of 5*l.* to the party grieved, with full costs.

Every person charged with any felony or other crime, who shall on his trial be acquitted, or against whom no indictment shall be found by the grand jury, or who shall be discharged by proclamation for want of prosecution, shall be immediately set at large in open court, without payment of any fee to the sheriff or gaoler, but in lieu thereof, the treasurer, on a certificate signed by one of the judges or justices before whom such prisoner shall have been discharged, shall pay out of the general rate of the county or district, such sum as has been usually paid, not exceeding 13*s.* [illegible]*d.*

But an action cannot be brought by the person acquitted against the prosecutor of the indictment, without obtaining a copy of the record of his indictment and acquittal; which in prosecutions for felony it is not usual to grant, if there is the least probable cause to found such prosecution upon. But an action on the case for a malicious prosecution may be founded on such an indictment whereon no acquittal can be, as if it is rejected by the grand jury, or is coram non judice, or is insufficiently drawn; for it is not the danger of the plaintiff, but the scandal, vexation, and expence, upon which this action is founded. However any probable cause for preferring it is sufficient to justify the defendant, provided it does not appear that the prosecution was malicious.

INDIGO. A blue colouring matter extracted from a plant called anil, or the indigo plant. In the preparation of this drug, the herb is put into a vat or cistern, called the steeping trough, and there covered with water. The matter begins to ferment sooner or later, according to the warmth of the weather and the maturity of the plant; sometimes in six or eight hours, and sometimes in not less than twenty. The liquor grows hot, throws up a plentiful froth, thickens by degrees, and acquires a blue colour inclining to violet. At this time, without touching the herb, the liquor impregnated with its tincture is let out by cocks in the bottom into another vat placed for that purpose, so as to be commanded by the first.

In the second vat, called the beating vat, the liquor is strongly and incessantly beaten with a kind of buckets fastened to poles, till the colouring matter is united into a body. As soon as it is judged, from the blue colour of the liquid, that the beating is sufficient, it is left at rest for two hours; after which the clear liquor is drawn off by cocks in the side of the vat, and the blue part is discharged by another cock into a third vat, where it is suffered to settle for some time longer; then conveyed in a half fluid state into bags of cloth, to strain off more of its moisture; and lastly, exposed to the air in the shade in shallow wooden boxes, till it is thoroughly dry.

Bergmann concludes, from his analysis, that 100 parts of good indigo contain of mucilaginous matter separable by water 12, resinous matter soluble in alcohol 6, earthy matter taken up by the acetic acid, which does not attack the iron, here, in the state of oxide, 22, oxide of iron taken up by the muriatic acid 13.

There remained 47 parts, which are the colouring matter, nearly in a state of purity, and afforded by distillation, carbonic acid 2, alkaline liquor 8, empyreumatic oil 9, coal 23.

The blue vat of the dyer contains indigo deoxidized by protoxide of iron, and rendered soluble in its yellow-green state by lime water. If a portion of this solution be exposed to the air, in a shallow vessel, the indigo will speedily absorb oxygen, and precipitate in its usual state of an insoluble blue powder. This being dried, and digested in a mixture of alcohol and muriatic acid, becomes also pure indigo by the abstraction of all the resin and lime. In this state, it is a soft powder, of an intensely deep blue, verging sometimes on purple. It is unchangeable by the air.

INDIVIDUAL, in logic, a particular being of any species, or that which cannot be divided

into two or more beings equal or alike. The usual division in logic is made into genera, those genera into species, and those species into individuals.

INDIVISIBLE, among metaphysicians. A thing is said to be indivisible absolute, absolutely indivisible, that is a simple being, and consists of no parts into which it may be divided. Thus God is indivisible in all respects, as is also the human mind, not having extension or other properties of body.

INDIVISIBLES, in geometry, the elements or principles into which any body or figure may be ultimately resolved; which elements are supposed infinitely small: thus a line may be said to consist of points, a surface of parallel lines, and a solid of parallel and similar surfaces; and then, because each of these elements is supposed indivisible, if in any figure a line be drawn through the elements perpendicularly, the number of points in that line will be the same as the number of the elements; whence we may see that a parallelogram, prism, or cylinder, is resolvable into elements or indivisibles, all equal to each other, parallel and like to the base; a triangle into lines parallel to the base, but decreasing in arithmetical proportion; and so are the circles which constitute the parabolic conoid, and those which constitute the plane of a circle, or surface of an isosceles cone.

INDORSEMENT, in law, any thing written on the back of a deed, as a receipt for money received. See Bills of Exchange.

INDUCEMENT, in law, what is alleged as a motive or incitement to a thing, and is used specially in many cases: as, there is an inducement in actions, to a traverse in pleadings, a fact or offence committed, &c.

INDUCTION, in law, is the giving a clerk instituted to a benefice, the actual possession of the temporalities thereof, in the nature of livery of seisin. It is performed by a mandate from the bishop to the archdeacon, who commonly issues out a precept to some other clergyman to perform it for them; which being done, the clergyman who inducts him indorses a certificate of his induction on the archdeacon's mandate, and they who were present testify the same under their hands, and by this the person inducted is in full and complete possession of all the temporalities of his church.

INERTIA *of matter*, is defined by Sir Isaac Newton to be a passive principle by which bodies persist in their motion or rest, receive motion in proportion to the force impressing it, and resist as much as they are resisted.

INFAMY, which extends to forgery, perjury, gross cheats, &c. disables a man to be a witness or a juror; but a pardon of crimes restores a person's credit to make him a good evidence.

INFANCY, the first part of life. Hoffman says, that the human species are *infants* until they begin to talk, and *children* to the age of puberty.

Anatomy has discovered to us, that during infancy there is much imperfection in the human frame. Its parts are disproportioned, and its organs incapable of those functions which in future life they are destined to perform. The head is larger in proportion to the bulk of the body than that of the adult. The liver and pancreas are much larger in proportion than in advanced life; their secretions are more in quantity also. The bile is very inert; the heart is stronger and larger than in future life; the quantity of blood sent through the heart of an infant, in a given time, is also more in proportion than in adults. And although these circumstances have their important usefulness, yet the imperfection attending them subjects this age to many infirmities, injuries, and dangers from which a more perfect state is exempted. Thus infants have a larger portion of brain than adults, hence are more subject to nervous disorders; and hence the diagnostics of disease are in many respects obscure or uncertain, particularly those taken from the pulse, which from the irritability of the tender bodies of infants, is suddenly affected by a variety of accidents too numerous, and seemingly too trivial to gain our attention.

INFANT. From the observations daily made on the actions of infants, as to their arriving at discretion, the laws and customs of every country have fixed upon particular periods, on which they are presumed capable of acting with reason and discretion; in our law the full age of man or woman is twenty-one years.

The ages of male and female are different for different purposes: a male at twelve years of age may take the oath of allegiance; at fourteen is at discretion, and therefore may consent or disagree to marriage, may choose his guardian, and if his discretion is actually proved, may make his testament of his personal estate; at seventeen he may be a procurator or an executor; and at twenty-one is at his own disposal, and may alien his lands, goods, and chattels. A female at seven years of age may be betrothed or given in marriage; at nine is entitled to dower; and at twelve is of years of maturity, and therefore may consent or disagree to marriage, and if proved to have sufficient discretion may bequeath her personal estate; at fourteen is at years of legal discretion, and may choose a guardian; at seventeen may be executrix; and at twenty-one may dispose of herself and her lands.

An infant is capable of inheriting, for the law presumes him capable of property; also an infant may purchase, because it is intended for his benefit and the freehold is in him till he disagrees thereto, because an agreement is presumed, it being for his benefit. And if at his full age the infant agrees to the purchase, he cannot afterwards avoid it; but if he dies during his minority his heirs may avoid it. As to infants being witnesses, there seems to be no fixed time at which children are excluded from giving evidence; but it will depend in a great measure on the sense and understanding of the children as it shall appear on examination in court.

An infant is not bound by his contract to deliver a thing; so if one deliver goods to an infant upon a contract, &c. knowing him to be an infant, he shall not be chargeable in trover and conversion, or any other action for them; for the infant is not capable of any contract but for necessaries, therefore such delivery is a gift to the infant; but if an infant, without any contract, wilfully takes away the goods of another, trover lies against him.

An infant, knowing of a fraud, shall be as much bound as if of age.

Where goods are furnished to the son, he is himself liable if they are necessaries. If tradesmen deal with him, and he undertakes to pay them, they must resort to him for payment; but if they furnished the infant on the credit of his father, the father only is liable.

With respect to education, &c. infants may be charged, where the credit was given bona fide to them. But where the infant is under the parents' power, and living in the house with them, he shall not be liable even for necessaries.

A promissory note given by an infant for board and lodging, and for teaching him a trade, is valid, and will support an action for the money. And debts contracted during infancy are good considerations to support a promise made to them when a person is of full age; but the promise must be express.

A bond without a penalty for necessaries will bind an infant, but not a bond with a penalty. Legacies to infants cannot be paid either to them or their parents.

By the custom of London an infant unmarried, and above the age of 14, if under 21, may bind himself apprentice to a freeman of London, by indenture with proper covenants, which covenants, by the custom of London, will be as binding as if of age. An infant cannot be sued but under the protection and joining the name of his guardian; but he may sue either by his guardian, or his next friend, who is not his guardian.

INFANTRY, in military affairs, denotes the whole body of foot soldiers.

INFINITE, that which has neither beginning nor end: in which sense God alone is infinite. See GOD.

INFINITE, or **INFINITELY** *great line*, in geometry, denotes only an indefinite or indeterminate line, to which no certain bounds or limits are prescribed.

INFINITESIMALS, among mathematicians, are defined to be infinitely small quantities.

In the method of infinitesimals, the element, by which any quantity increases or decreases, is supposed to be infinitely small, and is generally expressed by two or more terms, some of which are infinitely less than the rest, which being neglected as of no importance, the remaining terms form what is called the difference of the proposed quantity.

INFLECTION, or *point of inflection*, in the higher geometry, is the point where a curve begins to bend a contrary way.

INFLUENZA, a species of contagious catarrh, so named because it was supposed to be produced by a peculiar influence of the stars. The phenomena of contagious catarrhs have been much the same with those of the simple kind, but the disease has always been particularly remarkable for this, that it has been the most widely and generally spreading epidemic known. It has seldom appeared in any one country of Europe, without appearing successively in most of the others.

INFORMATION, in law, may be defined an accusation or complaint exhibited against a person for some criminal offence. It differs principally from an indictment in this, that an indictment is an accusation found by the oath of twelve men, but an information is only the allegation of the officer who exhibits it.

INFUSION, a method of obtaining the virtues of plants, roots, &c. by steeping them in a hot or cold liquid.

INFUSORIA, in natural history, minute simple animalcules, seldom visible to the naked eye. When water is examined with the microscope, particularly that which has long been stagnant, and has vegetable matter growing in it, or water in which vegetables have been infused, thousands of minute animals have been discovered, which have been arranged together in this order. When wheat that is richety is infused in water, small eel-shaped worms are discovered, which were the cause of the disease.

INGOT, is a small bar of metal made of a certain form and size, by casting it in hollowed iron or brass plates, called ingot-moulds. The term is chiefly applied to the small bars of gold and silver, intended either for coining, or exportation to foreign countries.

INHERITANCE, is a perpetuity in lands or tenements to a man and his heirs. Inheritances are corporeal or incorporeal. Corporeal inheritances relate to houses and lands which may be touched or handled; and incorporeal hereditaments are rights issuing out of, annexed to, or exercised with, corporeal inheritances: as advowsons, tithes, annuities, offices, commons, franchises, privileges, and services. There are several rules of inheritances of lands, according to which estates are transmitted from ancestor to heir, viz. 1. That inheritances shall lineally descend to the issue of the person last actually seised, in infinitum, but shall never lineally ascend. 2. The male issue shall be admitted before the female. 3. Where there are two or more males in equal degree the eldest only shall inherit; but the females all together. 4. The lineal descendants, in infinitum, of any person deceased shall represent their ancestor: thus, the child, grandchild, or great grandchild (either male or female,) of the eldest son, succeeds before the younger son, and so in infinitum. 5. On failure of issue of the person last seised, the inheritance shall descend to the blood of the first purchaser. 6. The collateral heir of the person last seised must be his next collateral kinsman of the whole blood. 7. In collateral inheritances the male stocks shall be preferred to the female, unless where lands are descended from a female.

INHIBITION, a writ to inhibit or forbid a judge from farther proceedings in the cause depending before him.

INJECTION, in surgery, the forcibly throwing certain liquid medicines into the body, by means of a syringe, tube, clyster-pipe, or the like.

INJECTION, *anatomical*, the filling the vessels with some coloured substance, in order to make their figures and ramifications visible.

INJUNCTION. An injunction is a prohibitory writ, restraining a person from committing or doing a thing which appears to be against equity and conscience.

An injunction is usually granted for the purpose of preserving property in dispute pending a suit; as to restrain the defendant from proceedings at the common law against the plaintiff, or from committing waste, or doing any injurious act.

Injunctions issue out of the courts of equity

is several instances. The most usual injunction is to stay proceedings at law; as, if one man brings an action at law against another, and a bill is brought to be relieved either against a penalty, or to stay proceedings at law, or some equitable circumstances, of which the party cannot have the benefit at law.

INK. Every liquor or pigment used for writing or printing, is distinguished by the name of ink. Common practice knows only black and red. Of black ink there are three principal kinds: 1. Indian ink; 2. Printers' ink; and 3. Writing ink.

The Indian ink is used in China for writing with a brush, and for painting upon the soft flexible paper of Chinese manufacture. It is ascertained, as well from experiment as from information, that the cakes of this ink are made of lamp-black and size, or animal glue, with the addition of perfumes or other substances not essential to its quality as an ink.

Good printers' ink is a black paint, smooth and uniform in its composition, of a firm black colour, and possesses a singular aptitude to adhere to paper thoroughly impregnated with moisture. Ten or twelve gallons of the oil are set over the fire in an iron pot, capable of holding at least half as much more; for the oil swells up greatly, and its boiling over into the fire would be very dangerous. When it boils it is kept stirring with an iron ladle; and if it do not itself take fire, it is kindled with a piece of flaming paper or wood; for simple boiling, without the actual ascension of the oil, does not communicate a sufficient degree of the drying quality required. The oil is suffered to burn for half an hour or more, and the flame being then extinguished by covering the vessel close, the boiling is afterwards continued with a gentle heat, till the oil appears of a proper consistence; in which state it is called varnish. It is necessary to have two kinds of this varnish, a thicker and a thinner, from the greater or less boiling, to be occasionally mixed together, as different purposes may require: that which answers well in hot weather being too thick in cold, and large characters not requiring so stiff an ink as small ones.

Lamp-black is the common material to give the black colour, of which two ounces and a half are sufficient for sixteen ounces of the varnish. Vermilion is a good red. They are ground together on a stone with a muller, in the same manner as oil paints.

The ink used by copper-plate printers differs in the oil, which is not so much boiled as to acquire the adhesive quality. This would render it less disposed to enter the cavities of the engraving, and more difficult either to be spread or wiped off. The black is likewise of a different kind. Instead of lampblack, or sublimed charcoal, the Frankfort black is used, which is a residual or denser charcoal, said to be made from vine-twigs. This is softer and less gritty than the ivory or other blacks prepared among us, and, no doubt, contains more coal than any animal residue, as all these abound with phosphate of lime.

Common ink for writing is made by adding an infusion or decoction of the nut-gall to sulphate of iron, dissolved in water. A very fine black precipitate is thrown down, the speedy subsidence of which is prevented by the addition of a proper quantity of gum-arabic.

M. Ribaucourt paid particular attention to the process for making black ink, and from his experiments he draws the following inferences:—That logwood is a useful ingredient in ink, because its colouring matter is disposed to unite with the oxide of iron, and renders it not only of a very dark colour, but less capable of change from the action of acids, or of the air. Sulphate of copper, in a certain proportion, gives depth and firmness to the colour of the ink. Gum-arabic, or any other pure gum, is of service, by retarding the precipitation of the feculæ; by preventing the ink from spreading or sinking into the paper; and by affording it a kind of compact varnish, or defence from the air when dry. Sugar appears to have some bad qualities, but is of use in giving a degree of fluidity to the ink, which permits the dose of gum to be enlarged beyond what the ink would bear without it. Water is the best solvent.

Lewis had supposed, that the defects of ink arise chiefly from a want of colouring matter. But the theory grounded on the fact discovered by M. Ribaucourt requires, that none of the principles should be in excess.

From all the foregoing considerations M. R. gives these directions for the composition of good ink: Take eight ounces of Aleppo galls (in coarse powder;) four ounces of logwood (in thin chips;) four ounces of sulphate of iron; three ounces of gum-arabic (in powder;) one ounce of sulphate of copper; and one ounce of sugar-candy. Boil the galls and logwood together in twelve pounds of water for one hour, or till half the liquid has evaporated. Strain the decoction through a hair sieve or linen cloth, and then add the other ingredients. Stir the mixture till the whole is dissolved, more especially the gum; after which, leave it to subside for twenty-four hours. Then decant the ink, and preserve it in bottles of glass or stone ware, well corked.

Many recommend, that the sulphate of iron should be calcined to whiteness. Mr. Desormeaux, jun. an ink manufacturer in Spitalfields, has given the following, in the Philosophical Magazine, as the result of much experience: —Boil four ounces of logwood about an hour in six beer quarts of water, adding boiling water from time to time; strain while hot; and when cold, add water enough to make the liquor five quarts. Into this put one pound averdup. of blue galls coarsely bruised; four ounces of sulphate of iron calcined to whiteness; three ounces of coarse brown sugar; six ounces of gum-arabic; and ¼ ounce of acetate of copper, triturated with a little of the decoction to a paste, and then thoroughly mixed with the rest. This is to be kept in a bottle uncorked about a fortnight, shaking it twice a-day, after which it may be poured from the dregs, and corked up for use.

Inks of other colours may be made from a strong decoction of the ingredients used in dyeing, mixed with a little alum and gum-arabic. For example, a strong decoction of Brazil wood, with as much alum as it can dissolve, and a little gum, forms a good red ink. These processes consist in forming a lake, and retarding its precipitation by the gum. See Lake.

Among the amusing experiments of the art of chemistry, the exhibition of sympathetic inks holds a distinguished place. With these the writing is invisible, until some re-agent gives it

opacity. We shall here mention a few out of the great number, that a slight acquaintance with chemistry may suggest to the student. 1. If a weak infusion of galls be used, the writing will be invisible till the paper be moistened with a weak solution of sulphate of iron. It then becomes black, because these ingredients form ink. 2. If paper be soaked in a weak infusion of galls, and dried, a pen dipped in the solution of sulphate of iron will write black on that paper, but colourless on any other paper. 3. The diluted solutions of gold and silver remain colourless upon the paper, till exposed to the sun's light, which gives a dark colour to the oxides, and renders them visible. 4. Most of the acids, or saline solutions, being diluted, and used to write with, become visible by heating before the fire, which concentrates them, and assists their action on the paper. 5. Diluted prussiate of potash affords blue letters when wetted with the solution of sulphate of iron. 6. The solution of cobalt in aqua regia, when diluted, affords an ink which becomes green when held to the fire, but disappears again when suffered to cool. This has been used in fanciful drawings of trees, the green leaves of which appear when warm, and vanish again by cold. If the heat be continued too long after the letters appear, it renders them permanent. 7. If oxide of cobalt be dissolved in acetic acid, and a little nitre added, the solution will exhibit a pale rose colour when heated, which disappears on cooling. 8. A solution of equal parts of sulphate of copper and muriate of ammonia, gives a yellow colour when heated, that disappears when cold.

Ink, *removing stains of.* The stains of ink on cloth, paper, or wood, may be removed by almost all acids; but those acids are to be preferred which are least likely to injure the texture of the stained substance. The muriatic acid, diluted with five or six times its weight of water, may be applied to the spot, and, after a minute or two, may be washed off, repeating the application as often as may be found necessary. But the vegetable acids are attended with less risk, and are equally effectual. A solution of the oxalic, citric (acid of lemons,) or tartareous acids, in water, may be applied to the most delicate fabrics without any danger of injuring them; and the same solutions will discharge writing, but not printing-ink. Hence they may be employed in cleaning books which have been defaced by writing on the margin, without impairing the text. Lemon-juice, and the juice of sorrel, will also remove ink-stains, but not so easily as the concrete acid of lemons, or citric acid.

INN, a place appointed for the entertainment and relief of travellers. If one who keeps a common inn refuse either to receive a traveller as a guest into his house, or to find him victuals or lodging, upon his tendering a reasonable price for them, he is not only liable to render the damages for the injury in an action on the case, at the suit of the party grieved, but also may be indicted and fined at the suit of the king. In return for such responsibility, the law allows him to retain the horse of his guest until paid for his keep; but he cannot retain such horse for the bill of the owner, although he may retain his goods for such bill; neither can he detain one horse for the food of another. An innkeeper, however, is not bound to receive the horse unless the master lodge there also; Neither is a landlord bound to furnish provisions, unless paid beforehand. If an innkeeper make out unreasonable bills, he may be indicted for extortion; and if either he or any of his servants knowingly sell bad wine, or bad provisions, they will be responsible in an action of deceit. Keeping an inn is not a trading to make a man a bankrupt; but where an innkeeper is a chapman also, and buys and sells, he may on that account be a bankrupt. Innkeepers are clearly chargeable for the goods of guests stolen or lost out of their inns, and this without any contract or agreement for that purpose. But if a person come to an innkeeper, and desire to be entertained by him, which the innkeeper refuses because in fact his house is already full; whereupon the party says, he will shift among the rest of his guests, and there he is robbed, the host shall not be charged. If a man come to a common inn to harbour, and desire that his horse may be put to grass, and the host put him to grass accordingly, and the horse is stolen, the host shall not be charged. Innkeepers may detain the person of the guest who eats till payment. By the custom of London and Exeter, if a man commit a horse to an hostler, and he eat out the price of his head, the hostler may sell him upon the reasonable appraisement of four of his neighbours; yet he cannot justify the taking him to himself at the price it was appraised at.

Inns *of court* are so called, because the students therein study the law, to enable them to practise in the courts at Westminster or elsewhere; and also because they use all other gentle exercises, as may render them better qualified to serve the king in his court.

INNATE *ideas*, those supposed to be stamped on the mind from the first moment of its existence, and which it constantly brings into the world with it: a doctrine which Mr. Locke has abundantly refuted.

INNOMINATA *ossa*, in anatomy, three bones, which compose the extreme part of the trunk of a human body.

INNUENDO, is a word used in declarations and law pleadings, to ascertain a person or thing which was named before; as to say he (innuendo the plaintiff) did so and so, when there was mention before of another person. Innuendo may serve for an explanation, where there is precedent matter, but never for a new charge; it may apply what is already expressed, but cannot add or enlarge the importance of it.

INOCULATION, in medicine, the art of transplanting a distemper from one subject to another, by incision, particularly used for ingrafting the small-pox. See Vaccination.

Inoculation. See Budding.

INORDINATE *proportion*, is where there are three magnitudes in one rank, and three others proportional to them in another, and you compare them in a different order. Thus suppose the numbers in one rank to be 2, 3, 9; and those of the other rank 8, 24, 36; which are compared in a different order, *viz.* 2 : 3 :: 24 : 36; and 3 : 9 :: 8 : 24. Then rejecting the mean terms of each rank, you conclude 2 : 9 :: 8 : 36.

INQUEST, in law, an inquisition by jurors, or a jury, which is the most usual trial of all causes, both civil and criminal, within this realm.

INQUISITION, in law, a manner of pro-

ceeding by way of search or examination used on the king's behalf, in cases of outlawry, treason, felony, self-murder, &c. to discover lands, goods, and the like, forfeited to the crown. Inquisition is also had upon extents of lands, tenements, &c. writs of elegit, and where judgment being had by default, damages and costs are recovered.

Inquisition, in the church of Rome, a tribunal in several Roman catholic countries, erected by the popes for the examination and punishment of heretics.

INROLLMENT, in law, is the registering, recording, or entering in the rolls of the Chancery, King's Bench, Common Pleas, or Exchequer, or by the clerk of the peace in the records of the quarter sessions, of any lawful act; a statute or recognizance acknowledged, a deed of bargain and sale of lands, and the like. By statute 27, Henry VIII. c. 16, no lands shall pass, whereby any estate of inheritance or freehold shall take effect, or any use thereof be made, by reason only of any bargain and sale thereof, except the bargain and sale be made by writing indented, sealed, and within six months inrolled in one of the king's courts of record at Westminster; or else within the county where the lands lie, before the clerk of the peace, and one or more justices. But by 5 Elizabeth, c. 26, in the counties palatine, they may be inrolled at the respective courts there, or at the assizes. Every deed before it is inrolled is to be acknowledged to be the deed of a party, before a master of chancery, or a judge of the court wherein it is inrolled, which is the officer's warrant for inrolling it; and the inrollment of a deed, if it be acknowledged by the grantor, it will be a good proof of the deed itself upon trial. But a deed may be inrolled without the examination of the party himself; for it is sufficient if oath be made of the execution.

INSCRIBED, in geometry. A figure is said to be inscribed in another when all its angles touch the sides or planes of the other figure.

INSECTS. See Entomology.

INSOLUBILITY, in chemistry. The insolubility of a substance in a fluid, which is the medium of chemical action, has an influence on that action somewhat similar to that of cohesion, and is nothing but a modification of it, in relation to the fluid in which it is exerted.

INSOLVENT *debtors.* Insolvent acts are statutes passed for the purpose of releasing from prison, and sometimes from their debts, persons whose transactions have not been of such a nature as would subject them to the bankrupt laws. Their discharge is usually from all suits and imprisonment, upon delivering up all their estates and effects, real and personal, for the benefit of their creditors.

INSPIRATION, among divines, &c. implies the conveying of certain extraordinary notices or motions into the mind; or it denotes any supernatural influence of God upon the mind of a rational creature, wherby he is formed to any degree of intellectual improvements, to which he could not have attained in his present circumstances, in a natural way. Thus the prophets are said to have spoken by divine inspiration.

Some writers reduce the inspiration of the Scriptures to a particular care of Providence, which prevented any thing they had said from failing or coming to nought; maintaining, that they never were really inspired either with knowledge or expression. According to others, inspiration is nothing more than a direction of the Holy Spirit, which never permitted the sacred writers to be mistaken. It is a common opinion, that the inspiration of the Holy Spirit regards only the matter, not the style or words.

There is scarcely any subject connected with theology that has called forth a greater display of talent than the vindication of the divine authority of the Scriptures, and the truth of the Christian religion. It is, however, an incontrovertible fact, that the ablest of such performances are more adapted to silence, than to satisfy, the mind of even an ingenuous inquirer. This painful truth is widely felt; and infidelity has recently taken a most unprecedented and unblushing advantage of it in this country. Yet however much such an event is to be deplored, we sincerely congratulate the friends of Christianity, on an acquisition of uncommon importance, which they have gained in the appearance of a volume from the pen of the Rev. Samuel Noble, of London, on the Plenary Inspiration of the Scriptures. This invaluable work contains six lectures delivered at Albion Hall, London Wall. The ground chosen by the Lecturer is entirely new; and the luminous and conclusive manner in which he pursues his argument, is such as to throw a radiance of celestial light around the most obscure portions of the sacred volume. The reader is furnished with a principle of interpretation which is at once of undeviating certainty, and universal application; and before which, the most ingenious and formidable objections that ever issued from the schools of infidelity, flee, like the shades of night, at the approach of the orb of day.

The rule to which we refer is afforded in the mutual relation which exists by creation between things natural or material, spiritual, or moral and divine; which is such that the lower order of objects answers to the higher, as certainly and immutably, as the reflection in a mirror answers to the substance producing it.

INSTALLMENT, the instating or establishing a person in some dignity. This word is chiefly used for the induction of a dean, prebendary, or other ecclesiastical dignitary, into the possession of his stall, or other proper seat in the cathedral to which he belongs. It is also used for the ceremony whereby the knights of the garter are placed in their rank in the chapel of St. George at Windsor, and on many other like occasions. It is sometimes termed installation.

INSTANT, such a part of duration wherein we perceive no succession; or it is that which takes up the time only of one idea in our minds.

INSTINCT, an appellation given to the sagacity and natural inclinations of brutes, which supplies the place of reason in mankind.

INSTITUTES, in literary history, a book containing the elements of the Roman law, and constitutes the last part of the civil law. The Institutes are divided into four books, and contain an abridgment of the whole body of the civil law, being designed for the use of students.

INSTITUTION, to a benefice, is that whereby the ordinary commits the cure of souls to the parson presented, as by induction he ob-

tains a temporal right to the profits of the living. Previous to the institution, the oath against simony, the oaths of allegiance and supremacy, are to be taken; and if it be a vicarage, the oath of residence. They are also to subscribe the thirty-nine articles, and the articles concerning the king's supremacy, and the book of common prayer.

INSULATED, in electricity, a term applied to bodies that are supported by electrics, or non-conductors, so that their communication with the earth, by conducting substances, is interrupted.

INSURANCE, or **Assurance**, in law and commerce, a contract or agreement whereby one or more persons, called insurers, assurers, &c. oblige themselves to answer for the loss of a ship, house, goods, &c. in consideration of a premium paid by the proprietors of the things insured.

INTAGLIOS, precious stones on which are engraven the heads of great men, inscriptions, and the like; such as we frequently see set in rings, seals, &c.

INTEGER, in arithmetic, a whole number, in contradistinction to a fraction.

INTEGRAL, or *integrant*, in philosophy, appellations given to parts of bodies which are of a similar nature with the whole: thus filings of iron have the same nature and properties as bars of iron.

INTEGRAL *calculus*. See **Calculus**.

INTEGUMENTS, in physiology, denote the common coverings which invest the body, as the cutis, &c. The common integuments are the skin, with the fat and cellular membrane adhering to it. The term integument is also extended to the particular membranes which invest certain parts of the body, as the coats or tunics of the eye.

INTEREST, is an allowance paid by the borrower to the lenders of money, for the use of it for a certain time. The sum lent is called the *principal*; the sum paid by the borrower, the interest; and both conjoined, the *amount*. If interest, after it becomes due, be incorporated with the principal, and interest be afterwards charged on the successive amounts, it gives rise to what is denominated *compound interest*, to distinguish it from simple interest, in which the interest, though foreborn, is charged only on the sum originally lent.

Simple Interest.

Let p denote principal, r the interest of £1. for one year, t the number of years the interest is due, and a the amount for the same time; then it is obvious that $a = p + r\,t$, or $a = p\,(1 + r\,t.)$ $p = \frac{a}{1 + r\,t}$, $r = \frac{a - p}{p\,t.}$, $t = \frac{a - p}{p\,r}$. Since r is the rate of £1. for one year, $\frac{r}{305}$ will be the rate for a single day; and therefore if d be the number of days, $\frac{d\,r}{305}$ will be the interest of £1. for the same time. If the rate be 5 *per cent.* or $\frac{1}{20}$, the interest of p pounds, for d days, will become $\frac{\frac{1}{20}\,p\,d}{365}$, or $\frac{p\,d}{7300}$.

Example:—What is the interest of £456, for 85 days at 5 *per cent.?*

$$\text{Interest} = \frac{456 \times 85}{7300} = £5:6:2\tfrac{1}{4}.$$

Compound Interest.

Let r now represent the amount of one pound in one year, that is, principal and interest; let n = the number of years; p = the principal; a = the amount. Then,

$1 : r :: r : r^2$ the amount of 1*l.* in 2 years,
$1 : r :: r^2 : r^3$ the amount of 1*l.* in 3 years,
$1 : r :: r^3 : r^4$ the amount of 1*l.* in 4 years, &c.

Whence it appears, that r raised to the power whose exponent is the given number of years, or r^n, will be the amount of 1*l.* in those years; and as

$$1l. : r^n :: p : a$$

from which the following theorems are easily deduced, viz. If the principal, time, and rate of interest are given, to find the amount:

Theo. 1. $p \times r^n = a$

If the amount, time, and rate are given, to find the principal?

Theo. 2. $\frac{a}{r^n} = p$

If the principal, amount, and time are given, to find the rate:

Theo. 3. $\sqrt[n]{\frac{a}{p}} = r$

If the principal, amount, and rate are given, to find the time:

Theo. 4. $\left\{ \frac{a}{p} = r^n \right.$, therefore $\frac{a}{p}$ being divided by r till nothing remains, the number of divisions will be n.

INTERJECTION, in grammar, an indeclinable part of speech, signifying some passion or emotion of the mind.

INTERLOCUTORY *order*, in law, an order that does not decide the cause, but only some matter incident to it, which happens between the beginning and end of a cause.

INTERLUDE, an entertainment exhibited on the stage, between the acts of a play, for the purpose of allowing the performers time to rest, the scenes to be shifted, &c.

INTERMITTENT, or **Intermitting Fevers**. See **Medicine**.

INTERNAL, in general, signifies whatever is within a thing.

Euclid proves that the sum of the three internal angles of every triangle is equal to two right angles; whence he deduces several useful corollaries. He likewise adduces, from the same proposition, this theorem, viz. that the sum of the angles of every rectilinear figure, is equal to twice as many right angles, as the figure hath sides, excepting or subtracting four.

INTERPOLATION, among critics, denotes a spurious passage, inserted into the writings of some ancient author. One great rule with regard to the expunging interpolations, is, that the restitution be perfectly agreeable to the rest of the work

INTERROGATION, or *point of* **Interrogation**, in grammar, a character of this form (?) serving to denote a question.

INTERSECTION, in the mathematics, signifies the cutting of one line or plane by another: thus we say, that the mutual intersection of two planes is a right line.

INTERVAL, in music, the difference between two sounds, in respect of acute and grave; or that imaginary space terminated

by two sounds, differing in acuteness or gravity.

Intervals are distinguished into simple and compound. A simple interval is without parts or divisions. Such are the octave, and all that are within it; as the second, third, fourth, fifth, sixth, and seventh, with their varieties. A compound interval consists of several lesser intervals; such are all those which are greater than the octave, as the ninth, tenth, eleventh, twelfth, &c. with their varieties.

INTESTATES. There are two kinds of intestates; one that makes no will at all; and another that makes a will, and nominates executors, but they refuse. The ordinary by special acts of parliament is required to give administration of the effects of the deceased to the widow or next of kin, who shall first pay the debts of the deceased, and then distribute the surplus among the kindred, in the proportions directed by 22 and 23 Car. II. c. 10.

INTESTINA, in natural history, the first of the five orders of the class vermes, in the Linnæan system. This order is described as of a formation the most simple, being naked animals without limbs. They live, some of them within other animals, some in waters, and a few in the earth. They are distinguished from the Mollusca, by the want of moveable appendages, or tentacula.

INTORSION, in botany, a term used to denote the bending of any of the parts of a plant towards one side. This admits of certain distinctions. 1. Twining stems, which bend towards the left, as in hops, honey-suckle, &c.; but in the kidney-bean, convolvolus, &c. they bend to the right. 2. Twining tendrils, which bend to the right and back again; of this kind are the tendrils of most of the pea-bloom or leguminous tribe of plants. 3. Twisted flowers, in the periwinkle, the petals bend to the left; the pointal in the viscous campion is twisted to the left, as the seed-bud is in the screw-tree. In oats, the beard which terminates the husk is twisted like a rope. This species of contorsion being affected by the moisture or dryness of the atmosphere, is denominated by Linnæus, "intorsio hygrometrica."

INTRINSIC, a term applied to the inner, real, and genuine values, properties, &c. of any thing, in opposition to their extrinsic or apparent values, &c.

INTUITION, the act whereby the mind perceives the agreement or disagreement of two ideas, immediately by themselves, without the intervention of any other; in which case, the mind perceives the truth as the eye doth the light, only by being directed towards it. Thus the mind perceives that white is not black, that three are more than two, and equal to one and two. This part of knowledge, says Mr. Locke, is irresistible; and like the sunshine, forces itself immediately to be perceived as soon as ever the mind turns its view that way. It is on this intuition that all the certainty and evidence of our other knowledge depend; this certainty every one finds to be so great, that he cannot imagine, and therefore cannot require, a greater.

INVECTED, in heraldry, denotes a thing fluted or furrowed. Invected is the reverse of ingrailed, in which the points are turned outward to the field, whereas in invected they are turned inward to the ordinary, and the small semicircles outward to the field.

INVECTIVE, in rhetoric, differs from reproof, as the latter proceeds from a friend, and is intended for the good of the person reproved: whereas the invective is the work of an enemy, and entirely designed to vex and give uneasiness to the person against whom it is directed.

INVOICE, an account in writing, of the particulars of merchandize, with their value, custom, charges, &c. transmitted by one merchant to another in a distant country. One copy of every invoice is to be inserted, verbatim, in the invoice-book, for the merchant's private use; and another copy must, immediately upon shipping off the goods, be dispatched by post, or otherwise, to the correspondent. An invoice has generally a letter of advice subjoined.

IODINE. This term is of Greek etymology, and literally signifies a *violet colour*. It has been recently introduced into the language of chemistry to denote a peculiar and hitherto undecompounded principle recently discovered.

Iodine was accidentally discovered in 1812, by M. De Courtois, a manufacturer of saltpetre at Paris. In his processes for procuring soda from the ashes of sea-weeds, he found the metallic vessels much corroded; and in searching for the cause of the corrosion, he made this important discovery.

Iodine derived its first illustration from MM. Clement and Desormes. In their memoir, read at a meeting of the Institute, these able chemists described its principal properties. They stated its sp. gr. to be about 4: that it becomes a violet-coloured gas, at a temperature below that of boiling water; that it combines with the metals, and with phosphorus and sulphur, and likewise with the alkalis and metallic oxides; that it forms a detonating compound with ammonia; that it is soluble in alcohol, and still more soluble in ether; and that by its action upon phosphorus, and upon hydrogen, a substance having the characters of muriatic acid is formed.

Iodine is a solid, of a greyish-black colour and metallic lustre. It is often in scales similar to those of micaceous iron ore, sometimes in rhomboidal plates, very large and very brilliant. It has been obtained in elongated octohedrons, nearly half an inch in length; the axes of which were shewn by Dr. Wollaston to be to each other, as the numbers 2, 3, and 4, at least so nearly, that in a body so volatile, it is scarcely possible to detect an error in this estimate, by the reflective goniometer. Its fracture is lamellated, and it is soft and friable to the touch. Its taste is very acrid, though it be very sparingly soluble in water. It is a deadly poison. It gives a deep brown stain to the skin, which soon vanishes by evaporation. In odour, and power of destroying vegetable colours, it resembles very dilute aqueous chlorine. The sp. gr. of iodine at 62½° is 4.948. It dissolves in 7000 parts of water. The solution is of an orange-yellow colour.

Iodine is incombustible, but with azote it forms a curious detonating compound; and in combining with several bodies, the intensity of mutual action is such as to produce the phenomena of combustion.

Iodine forms with sulphur a feeble compound, of a greyish-black colour, radiated like sulphuret of antomony. When it is distilled with water, iodine seperate.

Iodine and phosphorus combine with great rapidity at common temperatures, producing heat without light. From the presence of a little moisture, small quantities of hydriodic acid gas are exhaled. Oxygen expels iodine from both sulphur and phosphorus. "Hydrogen, whether dry or moist, did not seem," says M. Gay Lussac, " to have any action on iodine at the ordinary temperature; but if, as was done by M. Clement in an experiment at which I was present, we expose a mixture of hydrogen and iodine to a red heat in a tube, they unite together, and hydriodic acid is produced, which gives a reddish brown colour to water." Sir H. Davy threw the violet-coloured gas upon the flame of hydrogen, when it seemed to support its combustion. He also formed a compound of iodine with hydrogen, by heating to redness the two bodies in a glass tube.

Charcoal has no action upon iodine, either at a high or low temperature. Several of the common metals, on the contrary, as zinc, iron, tin, mercury, attack it readily, even at a low temperature, provided they be in a divided state. Though these combinations take place rapidly, they produce but little heat, and but rarely any light. The compound of iodine and zinc, or iodide of zinc, is white. It melts readily. Iron is acted on by iodine in the same way as zinc; and a brown iodide results, which is fusible at a red heat. It dissolves in water, forming a light green solution, like that of muriate of iron. Iodine and tin act very well on each other, in water of the temperature of 212°. By employing an excess of tin, we may obtain pure hydriodic acid, or at least an acid containing only traces of the metal. Antimony presents, with iodine, the same phenomena as tin; so that we might employ either for the preparation of hyriodic acid, if we were not acquainted with a preferable method. The iodides of lead, copper, bismuth, silver, and mercury, are insoluble in water, while the iodides of the very oxidizable metals are soluble in that liquid. If we mix a hydriodate with the metallic solutions, all the metals which do not decompose water will give precipitates, while those which decompose that liquid will give none. This is at least the case with the above mentioned metals. Dr. Coindet of Geneva has recommended the use of iodine in the form of tincture, and also hydriodate of potash or soda, as an efficacious remedy for the cure of glandular swellings of the goitrous and scrophulous kind.

JOINERY, the art of working in wood, or of fitting various pieces of timber together. It differs from the art of the carpenter, inasmuch as the joiner is employed chiefly in the inside work of a house, but the carpenter does the rough work, which, in general, requires more strength and less skill.

JOINT, *universal*, is an invention adapted to all kinds of motion and flexures; of this kind is the ball and socket joint, used in the construction of the theodolite, spirit-level, &c.

JOINT *actions*, in personal actions, several wrongs may be joined in one writ; but actions founded upon a tort and a contract cannot be joined, for they require different pleas and different process.

JOINT *lives*: lease for years to husband and wife, if they or any issue of their bodies should so long live, has been adjudged so long as either the husband, wife, or any of their issue should live; and not only so long as the husband and wife, &c. should jointly live.

JOINT *stock companies*, are commercial associations, having a stock consisting of many shares; in such associations the share-holders gain or lose according to the proportion in which they hold their shares. These associations are, in general, of but little advantage to individuals; those who profit most by them are the persons who are paid for managing them.

The most celebrated instances of companies of this description on record are those of the Mississipi scheme in France, and the South Sea scheme in England. The failure of these romantic speculations drew down ruin on many thousands, and the country in general was convulsed by the injuries sustained; yet, with such direful proofs of the certain consequences of all such Utopian speculations before their eyes, the people of England are, at the present hour, the dupes of a mania which unless the wisdom of the legislature interfere, must spread desolation to a far more fearful extent than ever was experienced from the bursting of the South Sea bubble.

JOINT *tenants*, are those that come to, and hold lands or tenements by one title, *pro indiviso*, or without partition. These are distinguished from sole or several tenants, from parceners, and from tenants in common; and they must jointly implead, and jointly be impleaded by others, which properly is common between them and co-parceners; but joint tenants have a sole quality of survivorship, which co-parceners have not. The creation of an estate in joint tenancy depends on the wording of the deed or devise, by which tenant claims title, and cannot arise by act of law. If any estate be given to a plurality of persons, without adding any restrictive, exclusive, or explanatory words, this makes them immediately joint tenants in fee of the lands. If there be two joint tenants, and one release the other, this passes a fee without the word heirs, because it refers to the whole fee, but the tenants in common cannot release each other, for a release supposes the party to have the thing in demand; but tenants in common have several distinct freeholds, which they cannot transfer otherwise than as persons who are sole seized

At common law, joint tenants in common were not compellable to make partition; except by the custom of some cities and boroughs. But now joint tenants may make partition; the one party may compel the other to make partition which must be by deed. that is to say, all the parties must by deed actually convey and assure to each other the several estates, which they are to take and enjoy severally and separately. Joint tenants must jointly implead, and be jointly impleaded with others. If one joint tenant refuse to join in an action, he may be summoned and severed; but if the person severed die, the writ abates in real actions, but not in personal and mixed actions.

IOLITE. Prismato-rhomboidal quartz of Mohs. Colour intermediate between violet-blue and blackish-blue. When viewed in the

direction of the axis of the crystals, the colour is dark indigo-blue; but perpendicular to the axis of the crystals, pale brownish-yellow. Massive, disseminated, rarely crystallized in six-sided prisms. Lustre vitreous. Fracture small grained uneven. Refracts double. Sp. gr. 2.5 to 2.6. Easily frangible. Its constituents are, silica 43.6, alumina 37.6, magnesia 9.7, potash 1, oxide of iron 4.5, oxide of manganese a trace.—*Gmelin.* It occurs in primitive rocks at Orijarvi, near Abo in Finland. It is cut and polished for a gem.

JOINTURE. A jointure, strictly speaking, signifies a joint estate, limited to both husband and wife; but in common acceptation, it extends also to a sole estate, limited to the wife only, and may be thus defined, viz. a competent livelihood of freehold for the wife of lands and tenements, to take effect, in profit or possession, presently after the death of the husband; for the life of the wife at least.

To the making of a perfect jointure six things are observed. 1. Her jointure is to take effect presently after her husband's decease. 2. It must be for the term of her own life, or greater estate. 3. It should be made to herself. 4. It must be made in satisfaction of her whole dower, and not of part of her dower. 5. It must either be expressed or averred to be in satisfaction of her dower. 6. It should be made during the coverture.

JOISTS, in architecture, those pieces of timber framed into the girders and summers, on which the boards of the floor are laid. See ARCHITECTURE and BUILDING.

IONIC *order*, the third of the five orders of architecture, being a kind of mean between the robust and delicate orders. See ARCHITECTURE.

IONIC *dialect* in grammar, a manner of speaking peculiar to the people of Ionia. The Ionians generally changed the ω into η, as σοφια into σοφιη; they put the η and ι for ε, and αιη for η, as αγγηϊον for αγγεῖον: αναγκαιη for αναγκη: they also change α and ει into ηϊ, αυ into ωϋ, ει into εα and εε, ευ into ω and ηϋ, and εο into ευ.

JOURNAL, a day-book, register, or an account of daily transactions. See Art. BOOK-KEEPING

JOURNEYMAN, properly one who works by the day only; but it is now used for any one who has served an apprenticeship, and who works under a master, either by the day, the year, or the piece.

JOY, one of the most powerful mental emotions accompanied with an extraordinary degree of animation and pleasure. The effect of joy, if not too violent, invigorates the whole animal frame. But sudden and excessive joy is often as injurious as the operation of either grief or terror, and there are a thousand instances on record, in which the precipitate communication of unexpected good news has proved fatal.

IRIDIUM, a new metal lately discovered by Mr. Tennant in the ore of platina. It is of a white colour, and perfectly infusible. It does not combine with sulphur or arsenic. Lead unites with it, but may be separated by cupellation. Copper, silver, and gold, are found to combine with it. See CHEMISTRY.

IRIS, in anatomy, a striped, variegated circle round the pupil of the eye; it is formed of a duplicature of the uvea. See ANATOMY.

IRIS, the flower-de-luce, or flag-flower, &c.; a genus of the monogynia order in the triandria class of plants; and in the natural method ranking under the sixth order, ensatæ. The corolla is divided into six parts; the petals alternately reflexed; the stigmata resembling petals.

There are fifty species, all herbaceous flowering perennials, both of the fibrous, tuberous, and bulbous-rooted kind, producing thick annual stalks from three or four inches to a yard high, terminated by large hexapetalous flowers, having three of the petals reflexed quite back, and three erect; most of which are very ornamental, appearing in May, June, and July.

IRIS also signifies those changeable colours which appear in the glasses of telescopes, microscopes, &c. and which are so called from their resembling the colours of the rainbow.

IRON, the most abundant and the most useful of all metals, was neither known so early, nor wrought so easily as gold, silver, and copper. Iron is of a bluish white colour; and when polished has a great deal of brilliancy. It has a styptic taste, and emits a smell when rubbed. This metal is easily oxidized. A piece of iron wire, immersed in a jar of oxygen gas, being ignited at one end, will be entirely consumed by the successive combustion of its parts. It requires a very intense heat to fuse it; on which account it can only be brought into the shape of tools and utensils by hammering. This high degree of infusibility would deprive it of the most valuable property of metals, namely, the uniting of smaller masses into one, if it did not possess another singular and advantageous property, which is found in no other metal except platina, namely, that of welding. In a white heat, iron appears as if covered with a kind of varnish, and in this state if two pieces be applied together, they will adhere, and may be perfectly united by forging.

When iron is exposed to the action of moist air or water, it acquires weight by gradual oxidation, and hydrogen gas escapes: this is a very slow operation. But if the steam of water be made to pass through a red-hot gun barrel, or through an ignited copper or glass-tube, containing iron wire, the iron becomes converted into an oxide, while hydrogen gas passes out at the other end of the barrel. By the action of stronger heat this becomes a reddish-brown oxide. Sulphur combines very readily with iron. A mixture of iron filings and flowers of sulphur being moistened, or made into a paste with water, becomes hot, swells, adheres together, breaks, and emits watery vapours of an hepatic smell. If the mixture be considerable in quantity, as for example, one hundred pounds, it takes fire in twenty or thirty hours, as soon as the aqueous vapours cease. By fusion with iron, sulphur produces a compound of the same nature as the pyrites, and exhibits the same radiated structure when broken. If a bar of iron be heated to whiteness, and then touched with a roll of sulphur, the two substances combine, and drop down together in a fluid state. Phosphorus may be combined with iron by adding it, cut into small pieces, to fine iron wire heated moderately red in a crucible; or by fusing six parts of iron clippings, with six of glacial phosphoric acid, and one of charcoal powder. This phosphuret is magnetic. Iron

unites with gold, silver, and platina. When heated to a white heat, and plunged in mercury, it becomes covered with a coating of that metal.

There are a great many varieties of iron, which are distinguished by particular names; but all of them may be reduced under one or other of the three following classes: cast iron; wrought or soft iron; and steel. Cast, or pig iron, is the name of the metal when first extracted from its ores. The ores from which iron is usually obtained are composed of oxide of iron and clay. The object of the manufacturer is to reduce the oxide to the metallic state, and to separate all the clay with which it is combined. These two objects are accomplished at once, by mixing the ore reduced to small pieces with a certain portion of limestone and of charcoal, and subjecting the whole to a very violent heat in furnaces constructed for the purpose. The charcoal absorbs the oxygen of the oxide, flies off in the state of carbonic acid gas, and leaves the iron in the metallic state; the lime combines with the clay, and both together run into fusion, and form a kind of fluid glass; the iron is also melted by the violence of the heat, and being heavier than the glass, falls down, and is collected at the bottom of the furnace. A hole at the lower part of the furnace is now opened, and the iron allowed to flow out into moulds prepared for its reception.

To convert it into wrought iron, it is put into a furnace, and kept melted, by means of the flame of the combustibles, which is made to play upon its surface. While melted, it is constantly stirred by a workman, that every part of it may be exposed to the air. In about an hour the hottest part of the mass begins to heave and swell, and to emit a lambent blue flame. This continues nearly an hour; and by that time the conversion is completed. As the process advances, the iron gradually acquires more consistency; and at last, notwithstanding the continuance of the heat, it congeals all together. It is then taken while hot, and hammered violently, by means of a heavy hammer driven by machinery. This not only makes the particles of iron approach nearer each other, but drives away several impurities which would otherwise continue attached to the iron.

If the purest malleable iron be bedded in pounded charcoal, in a covered crucible, and kept for a certain number of hours in a strong red heat, it is found, that by this operation, which is called cementation, the iron has gained a small addition of weight, amounting to about the hundred and fiftieth, or the two-hundredth part; and is remarkably changed in its properties. It is much more brittle and fusible than before. Its surface is commonly blistered when it comes out of the crucible; and it requires to be forged, to bring its parts together into a firm and continuous state. This cemented iron is called steel. It may be welded like bar iron, if it has not been fused, or over-cemented; but its most useful and advantageous property is that of becoming extremely hard when ignited and plunged into cold water.

The usual time required for the cementation of steel is from six to ten hours. If the cementation be continued too long, the steel becomes porous, brittle, of a darker fracture, more fusible, and incapable of being forged or welded. On the contrary, steel cemented with earthy infusible powders, is gradually reduced to the state of forged iron again. The texture of steel is rendered more uniform by fusing it before it is made into bars: this is called cast steel; and is rather more difficultly wrought than common steel, because it is more fusible, and is dispersed under the hammer if heated to a white heat. Iron is one of the most valuable articles of the materia medica. The protoxide acts as a genial stimulant and tonic, in all cases of chronic debility not connected with organic congestion or inflammation. It is peculiarly efficacious in chlorosis. It appears that the peroxide and its combinations are almost uniformly irritating, causing heart-burn, febrile heat, and quickness of pulse. Many chalybeate mineral waters contain an exceedingly minute quantity of protocarbonate of iron, and yet exercise an astonishing power in recruiting the exhausted frame. Their virtue appears to be derived simply from the metal being oxidized to a minimum, and diffused by the agency of a mild acid through a great body of water, in which state it is rapidly taken up by the lacteals, and speedily imparts a ruddy hue to the wan countenance. These qualities may be imitated exactly, by dissolving 3 grains of sulphate of iron, and 60 of bicarbonate of potash, in a quart of cool water, with agitation in a close vessel.

IRRATIONAL, an appellation given to surd numbers and quantities. See ALGEBRA.

IRREGULAR, in grammar, such inflections of words as vary from the general rules; thus we say, irregular nouns, irregular verbs.

IRRIGATION. See AGRICULTURE.

ISATIS, *woad;* a genus of the siliquosa order, in the tetradynamia class of plants; and in the natural method ranking under the 39th order, the siliquosa. The siliqua is lanceolated, unilocular, monospermous, bivalved, and deciduous; the valves navicular or canoe-shaped. There are four species; but the only one worthy of notice is the tinctoria, or common woad, which is cultivated in several parts of Britain for the purposes of dyeing, being used as a foundation for many of the dark colours. See DYEING.

ISERINE, in mineralogy, a species of the menachine genus: it is of an iron-black, inclining a little to the brownest black; it occurs in small, obtuse, angular grains, and in rolled pieces, with a rough glimmering surface. Internally it is glittering, and its lustre is semi-metallic. Specific gravity, 4.6. It melts into a blackish-brown coloured glass.

ISINGLASS. This substance is almost wholly gelatin; 100 grains of good dry isinglass containing rather more than 98 of matter soluble in water.

Isinglass is made from certain fish found in the Danube, and the rivers of Muscovy. Willoughby and others inform us, that it is made of the sound of the Beluga; and Neumann, that it is made of the Huso Germanorum, and other fish, which he has frequently seen sold in the public markets of Vienna. Mr. Jackson remarks, that the sounds of cod, properly prepared, afford this substance; and that the lakes of America abound with fish from which the very finest sort may be obtained.

Isinglass receives its different shapes in the following manner:—The parts of which it is composed, particularly the sounds, are taken from the fish while sweet and fresh, slit open,

washed from their slimy *sordes*, divested of a very thin membrane which envelopes the sound, and then exposed to stiffen a little in the air. In this state they are formed into rolls about the thickness of a finger, and in length according to the intended size of the staple; a thin membrane is generally selected for the centre of the roll, round which the rest are folded alternately, and about half an inch of each extremity of the roll is turned inwards. Isinglass is best made in the summer, as frost gives it a disagreeable colour, deprives it of weight, and impairs its gelatinous principles. Isinglass boiled in milk forms a mild nutritious jelly, and is thus sometimes employed medicinally. This, when flavoured by the art of the cook, is the blanc-manger of our tables. A solution of isinglass in water, with a very small proportion of some balsam, spread on black silk, is the court-plaster of the shops.

ISIS, *coral*, in natural history, a genus of the vermes zoophyta class and order, of which there are six species. See CORALLINES.

ISLAND, or ICELAND, *crystal*, a body famous among the writers of optics, for its property of a double refraction; but improperly called by that name, as it has none of the distinguishing characters of crystal, and is plainly a body of another class. Dr. Hill has reduced it to its proper class, and determined it to be of a genus of spars. It is always found in form of an oblique parallelopiped, with six sides, and is found of various sizes, from a quarter of an inch to three inches or more in diameter. It is pellucid, and not much less bright than the purest crystal, and its planes are all tolerably smooth, though when nicely viewed, they are found to be waved with crooked lines made by the edges of imperfect plates. It is very soft, and easily scratched with the point of a pin; it will not give fire on being struck against steel, and ferments and is perfectly dissolved in aquafortis. It is found in Iceland, from whence it has its name; and in France, Germany, and many other places.

ISNARDIA, a genus of the monogynia order, in the tetrandia class of plants; and in the natural method ranking under the 17th order, calycanthemæ. There is one species, an aquatic and annual.

ISOCELES *triangle*, in geometry, one that has two equal sides.

ISOCHRONAL, *isochrone*, or ISOCHRONUS, is applied to such vibrations of a pendulum, as are performed in the same space of time.

ISOCHRONAL *line*, that in which a heavy body is supposed to descend without any acceleration.

ISOPERIMETRICAL *figures*, in geometry, are such as have equal perimeters, or circumferences.

1. Of isoperimetrical figures, that is the greatest which contains the greatest number of sides, or the most angles, and consequently a circle is the greatest of all figures that have the same ambit as it has.

2. Of two isoperimetrical triangles, having the same base, whereof two sides of one are equal, and of the other unequal, that is the greater of which two sides are equal.

3. Of isoperimetrical figures, whose sides are equal in number, that is the greatest which is equilateral and equiangular.

ISOCELES, *triangle*, in geometry, one that has two equal sides. See GEOMETRY.

ISSUE, in law, is sometimes used for the children begotten between a man and his wife: sometimes for profit growing from amercements or fines; and sometimes for profits of lands or tenements; sometimes for that point of matter depending in a suit, when, in the course of pleading, the parties in the case affirm a thing on one side, and deny it on the other, they are then said to be at issue.

ISSUES, in surgery, are little ulcers made designedly by the surgeon in various parts of the body, and kept open by the patient for the preservation or recovery of his health.

ITCH, a cutaneous disease, supposed to be caused by an insect, a species of the genus Acarus, viz. A. scabiei, which, when viewed by a good microscope, is white with reddish legs; the four hind ones having a long bristle. It is found in the small pellucid vesicles with which the hands and joints of persons infected with the itch are covered. It appears to be not only the cause of the disorder, but the reason why it is so highly infectious.

ITCHING, an uneasy sensation, which occasions a desire of scratching the place affected. It is frequently a troublesome sensation, but more nearly allied to pleasure than pain. As pain is supposed to proceed from too great an irritation, so does itching proceed from a slight one.

JUBILEE. This term, as at present used, signifies a grand solemnity celebrated at Rome, on which occasion the Pope grants a plenary indulgence to all descriptions of sinners; at least to as many as visit the churches of St. Peter and St. Paul at Rome. This ceremony, which is a gross perversion of the Jewish Jubilee mentioned in Scripture, was first instituted by Boniface VII. in 1300, and was only to be observed every hundred years; but as it has been found to bring in such stores of wealth to Rome, the Pope grants a jubilee as often as he and the church have occasion for it. The jubilee lasts a whole year; and was well named by the Germans the *golden year*. This year, 1825, happens to afford one of these profitable mock solemnities.

JUDGE. The judges are the chief magistrates in the law, to try civil and criminal causes. Of these there are twelve in England, viz. the Lords Chief Justices of the Courts of King's Bench and Common Pleas; the Lord Chief Baron of the Exchequer; the three puisne or inferior judges of the two former courts, and the three puisne barons of the latter. The judges are to continue in their offices during their good behaviour, notwithstanding any demise of the crown, and their full salaries are absolutely secured to them during the continuance of their commissions, by which means the judges are rendered completely independent of the king, his ministers, or his successors. A judge at his creation takes an oath that he will serve the king, and indifferently administer justice to all men, without respect of persons, take no bribe, give no counsel where he is a party, nor deny right to any, though the king or any other, by letters, or by expressed words, command the contrary, &c. and in default of duty, to be answerable to the king in body, land, and goods.

Where a judge has an interest, neither he nor his deputy can determine a cause, or sit in court, and if he do, a prohibition lies. Judges are punishable for wilful offences against the duty of their situations; instances of which happily live only in remembrance. A judge is not answerable to the king, or the party, for mistakes or errors in his judgment, in a matter of which he has jurisdiction.

JUDGMENT, among logicians, a faculty or rather act of the human soul, whereby it compares its ideas, and perceives their agreement or disagreement.

JUDGMENT. The opinion of the judges is so called, and is the very voice and final doom of the law, and therefore is always taken for unquestionable truth.

JUDGMENTS are of four sorts, viz. 1. Where the facts are confessed by the parties, and the law determined by the court, which is termed judgment by demurrer.

2. Where the law is admitted by the parties, and the facts only are disputed, as in judgment upon a demurrer.

3. Where both the fact and the law arising thereon are admitted by the defendant, as in case of judgment by confession or default.

4. Where the plaintiff is convinced that fact or law, or both, are insufficient to support his action, and therefore abandons or withdraws his prosecution, as in case of judgment upon a nonsuit or retraxit. Judgments are either interlocutory or final.

Interlocutory judgments are such as are given in the middle of a cause, upon some plea, proceeding, or default, which is only intermediate, and does not finally determine or complete the suit; as upon dilatory pleas, when the judgment in many cases is, that the defendant shall answer over; that is, put in a more substantial plea.

Final judgments, are such as at once put an end to the action by declaring that the plaintiff has either entitled himself, or has not, to recover the remedy for which he sues.

JUGLANS, the *walnut*, a genus of the monœcia class, and polyandria order of plants; and in the natural method ranking under the 50th order, amentaceæ. The male calyx is monophyllous, and squamiform; the corolla divided into six parts; there are 18 filaments; the female calyx is quadrifid superior; the corolla quadripartite; there are two styles, and the fruit is a plum with a furrowed kernel. There are eight species, the most remarkable of which is the regia or common walnut. Other two species, called the nigra and alba, or black and white Virginian walnut are also cultivated in this country, though they are less proper for fruit, having very small kernels.

The wood of the walnut tree is much used by cabinet-makers, coach-makers, and gun-smiths; is susceptible of a very fine polish, and exhibits a beautiful grain.

JUGULAR. See ANATOMY.

JUGULARES, in the Linnæan system, is the name of an order or division of fish, the general character of which is that they have ventral fins.

JULIAN *period*, in chronology, a system or period of 7980 years, found by multiplying the three cycles of the sun, moon, and indiction into one another. See CHRONOLOGY. This period was called the Julian, not because invented by Julius Cæsar; since the Julian epocha was not received till the year 4669, but because the system consists of Julian years.

JUNCUS, the rush, a genus of the monogynia order, in the hexandria class of plants; and in the natural method ranking under the 5th order, tripetaloideæ. The calyx is hexaphyllous; there is no corolla; the capsule is unilocular. There are 29 species universally known, being very troublesome weeds, and difficult to be eradicated. The pith of two kinds, called the conglomeratus and effusus, or round-headed and soft rushes, is used for wicks to lamps and rushlights. The conglomeratus, and aculus or marine rush, are planted with great care on the banks of the sea in Holland, in order to prevent the water from washing away the earth; which would otherwise be removed every tide, were it not for the roots of those rushes, which fasten very deep in the ground, and mat themselves near the surface in such a manner as to hold the earth closely together.

JUNGERMANNIA, a genus of the natural order of algæ, in the cryptogamia class of plants. There are 48 species, all natives of Britain, growing in woods, shady places, by the sides of ditches, &c. Many of them are beautiful objects for the microscope.

JUNIPERUS, the juniper tree; a genus of the monadelphia order, in the monœcia class of plants; and in the natural method ranking under the 51st order, coniferæ. The male amentum is a calyx of scales; there is no corolla; three stamina; the female calyx tripartite; there are three petals, and as many stiles; the berry is trispermous, and equal, by means of three tubercles of the indurated calyx adhering to it. There are 12 species; the most remarkable are, 1. The communis, or common juniper, grows naturally in many parts of Britain upon dry barren commons, where it seldom rises above the height of a low shrub, which grows naturally only in dry, chalky, or sandy land. Juniper-berries have a strong, not disagreeable smell; and a warm, pungent, sweet taste, which, if they are long chewed, or previously well bruised, is followed by a bitterish one. The pungency seems to reside in the bark; the sweet in the juice; the aromatic flavour in oily vesicles spread through the substance of the pulp, and distinguishable even by the eye; and the bitter in the seeds.

JUPITER, ♃, in astronomy, one of the superior planets, remarkable for its great brightness. See ASTRONOMY.

JURY. This strong tower of defence of the British Constitution, which is one of the leading features of the Magna Charta, is composed of a certain number of persons sworn to enquire of, and try some fact, and declare the truth upon the evidence brought before them.

Juries are divided into two kinds, viz. common and special. A common jury is such as is returned by the sheriff, according to the directions of the statute 3 Geo. II. cap. 25, which appoints that the sheriff's officer shall not return a separate pannel for every separate cause, but one and the same pannel for every cause to be tried at the same assizes, containing not less than forty-eight, nor more than seventy-two jurors; and their names being written on tickets

shall be put into a box or glass, and when each cause is called, twelve of those persons whose names shall be first drawn out of the box shall be sworn upon a jury, unless absent, challenged, or excused. When a sufficient number of persons are impanelled, they are then separately sworn, well and truly to try the issue between the parties, and a true verdict give according to the evidence.

Special juries were originally introduced in trials at bar, when the causes were of too great nicety for the discussion of ordinary freeholders. To obtain a special jury, a motion is made in court, and a rule is granted thereupon, for the sheriff to attend the master, prothonotary, or other proper officer, with his freeholder's book, and the officer is to take indifferently forty-eight of the principal freeholders, in the presence of the attornies on both sides, who are each of them to strike off twelve, and the remaining twenty-four are returned upon the panel. Jurors are punishable for sending for, or receiving, instructions from either of the parties concerning the matter in question. In causes of nisi prius, every person whose name shall be drawn, and who shall not appear after being openly called upon three times, shall, on oath made of his having been lawfully summoned, forfeit a sum not exceeding 5*l.*, nor less than 40*s.*, unless some reasonable cause of absence be proved, by oath or affidavit, to the satisfaction of the judge. If any juror shall take of either party to give his verdict, he shall, on conviction, by bill or plaint, before the court where the verdict shall pass, forfeit ten times as much as he has taken; half to the king, and half to him who shall sue. A man who shall assault or threaten a juror for giving a verdict against him, is highly punishable by fine and imprisonment; and if he strike him in the court, in the presence of the judge of assize, he shall lose his hand and his goods, and the profits of his lands during life, and suffer perpetual imprisonment.

IVORY. The tusk, or tooth of defence of the male elephant. It is an intermediate substance between bone and horn, not capable of being softened by fire, not altogether so hard and brittle as bone. Sometimes it grows to an enormous size, so as to weigh near two hundred pounds. The entire tooth is of a yellowish, brownish, and sometimes a dark brown colour on the outside, internally white, hollow towards the root, and so far as was inserted into the jaw, of a blackish-brown colour. The finest, whitest, smoothest, and most compact ivory comes from the island of Ceylon. The grand consumption of this commodity is for making ornamental utensils, mathematical instruments, cases, boxes, balls, combs, dice, and an infinity of toys. The workmen have methods also of tinging it to a variety of colours.

The coal of ivory is used in the arts under the denomination of ivory black. Particular vessels are used in the manufacture of this pigment, for the purpose of rendering it perfectly black. Some travellers speak of the tooth of the sea-horse as an excellent ivory; but it is too hard to be sawed or wrought like ivory. It is used for making artificial teeth

JURY-*mast*, whatever is set up in room of a mast that has been lost in a storm or in an engagement, and to which a lesser yard, ropes, and sails are fixed.

JUSSIÆA, a genus of the monogynia order, in the decandria class of plants; and in the natural method ranking under the 17th order, calycanthemæ. There are 11 species, mostly herbaceous plants of the West Indies.

JUSTICE, in a legal sense, a person deputed by the king to administer justice to his subjects, whose authority arises from his deputation, and not by right of magistracy. In the courts of king's bench and common pleas there are two judges styled chief justices, each of whom retains the title of lord during the time of his continuing in office. The first of these, who is styled lord chief justice of England, has a very extensive power and jurisdiction in pleas of the crown. He hears all pleas in civil causes brought before him in the court of king's bench, and also the pleas of the crown; while, on the other hand, the lord chief justice of the common pleas has the hearing of all civil causes between common persons. Besides the lords chief justices, there are in each of the above courts three puisne justices; there are also several other justices appointed by the king for the execution of the laws; such as the lords justices in eyre of the forests, who are two justices appointed to determine all offences committed in the king's forests; justices of assize, of oyer and terminer, of gaol delivery, &c. They are also called justices of nisi prius, and so denominated from the words used in a common form of adjournment of a cause in the court of common pleas.

Justices *of the Peace*. See Peace.

JUSTICIARY, or court of Justiciary, in Scotland, a court of supreme jurisdiction in all criminal cases.

This court came in place of the justice-eyre or justice-general, which last was taken away by parliament in 1672, and was erected into a justice or criminal court, consisting of a justice-general alterable at the monarch's pleasure, justice-clerk, and five other judges, who are lords of session.

JUSTICIES, a writ directed to a sheriff, by virtue of which he is empowered to hold a plea of debt in his county-court for a sum above 40*s.* though by his ordinary power he has only cognizance of sums under 40*s.*

JUSTIFICATION, in law, is an affirming or shewing good reason in court, why one does such a thing as he is called to answer; as to justify in a cause of a replevin.

IVY. See Hedera.

IXIA, a genus of the monogynia order, in the triandria class of plants; and in the natural method ranking under the sixth order, ensatæ. The corolla is hexapetalous, patent, and equal; there are three stigmata, a little upright and petalous. There are fifty-four species, consisting of herbaceous, tuberous, and bulbous-rooted flowery perennials, from one to two feet high, terminated by hexapetalous flowers of different colours

K.

K, or k, the tenth letter of the English alphabet; it is derived from the Greek K or κ and seems to have been unknown to the Romans, though we sometimes meet with kalendar for calendar. As a numeral. K denotes 250; and with a line over it, K 250,000.

KÆMPFERIA, *zedoary*, a genus of the monogynia order, in the monandria class of plants, and in the natural method ranking under the eighth order, scitamineæ. The corolla is sexpartite, with three of the segments larger than the rest, patulous; and one only bipartite. The species are, 1. The [illegible] galanga, common galangal, or long zedoary. 2. The rotunda, or round zedoary. Both are perennial in root; but the leaves rise annually in spring, and decay in winter.

KALEIDOSCOPE. This term has been applied to designate a new optical instrument, invented by Dr. Brewster, of Edinburgh, for the purpose of creating and exhibiting an endless variety of beautiful and perfectly symmetrical figures. The word is of Greek derivation, and is compounded of καλος, *beautiful*, ειδος, *a form*, and σκοπεω, *to see*.

The kaleidoscope is an instrument so well known, that a particular description of it would be superfluous. It may, therefore, suffice simply to state the principles of its construction. When the instrument was brought by the inventor to something like a state of perfection, Dr. Brewster, at the solicitation of his friends, took out a patent for it, as a "new optical instrument for creating and exhibiting beautiful forms." In the specification of his patent, he describes the kaleidoscope in two different forms. The first consists of two reflecting planes, placed in a tube with an eye-hole in the particular position, which gives symmetry and a maximum uniformity of light, and with objects, such as coloured glass, *placed in the position of symmetry, and put in motion, either by a rotary movement, or by their own gravity, or by both combined.*

The second form of the instrument, described in the specification, is, when the tube containing the reflectors is placed in a second tube, at the end of which is a convex lens, which introduces into the picture objects of all magnitudes, and at every distance.

The kaleidoscope has been fitted up in a very elegant and scientific manner by the opticians of London; its utility has been experienced chiefly by calico-printers, potters, and carpet manufacturers: as a source of amusement it is endless, as the changes effected by its motion are ever varying. No instrument ever produced such an effect on the public feeling; but it must be owned that it lost much which it might otherwise have gained in the public estimation, by the thousands of unscientific imitations of it, which were sold in every part of the country, when the invention became known.

KALI, a genus of marine plants, which are burnt to procure mineral alkali.

KALMIA, a genus of the monogynia order, in the decandria class of plants, and in the natural method ranking under the 18th order bicornes. Of this genus there are four species. Those chiefly in cultivation with us are,

1. The latifolia, a most beautiful shrub, which rises usually to the height of five or six feet, and sometimes twice that height in its native places. This plant is a native of Carolina, Virginia, and other parts of America, yet it is not common; it grows on rocks hanging over rivulets, and on the sides of barren hills.

2. The angustifolia, rises to the height of about 16 feet, with evergreen leaves. flowers grow in clusters, and when blown, appear white; but on a near view, are of a faint bluish colour, which, as the flower decays, grows paler.

KAMSIN, a hot southerly wind, common in Egypt. It prevails more or less for fifty days. The sky becomes dark and heavy, the sun loses its splendour, and appears of a violet colour; the air is not cloudy, but grey and thick, and is filled with a dust so subtile, that it penetrates every where. This wind, always light and rapid, is not at first remarkably hot, but it increases in heat in proportion as it continues. The lungs, which a too rarefied air no longer expands, are contracted and become painful. Respiration is short and difficult, the skin parched and dry, and the body consumed by an internal heat. It usually lasts three days, but if it exceeds that time, it becomes insupportable. The danger is most imminent when it blows in squalls; for then the rapidity of the wind increases the heat to such a degree as to cause sudden death. This death is a real suffocation. The best mode of preventing the effects of it is to stop the nose and mouth with handkerchiefs. The camels, on this occasion, bury their noses in the sand, and keep them there till the squall is over. Another quality of this wind is its extreme aridity; which is such, that water sprinkled on the floor evaporates in a few minutes.

KAOLIN, the name of an earth which is used as one of the two ingredients in oriental porcelain.

KEDDING, in the sea-language, is when a ship is brought up or down a river by means of the tide, the wind being contrary.

KEEL, the lowest piece of timber in a ship, running her whole length from the lower part of her stem to the lower part of her stern-post. Into it are all the lower futtocks fastened; and under part of it, a false keel is often used.

Keel-*hauling*, a punishment inflicted for various offences in the Dutch navy. It is performed by suspending the culprit by a rope from one yard-arm, with a weight of lead or iron upon his legs, and having another rope fastened to him, leading under the ship's bottom, and through a block at its opposite yard-arm; he is then repeatedly and suddenly let fall from the one yard-arm into the sea, where passing under the ship's bottom, he is hoisted upon the opposite side of the vessel to the other.

KEELERS, among seamen, are small tubs, which hold stuff for the caulking of ships.

KEELSON, a principal timber in a ship, fayed within-side cross all the floor-timbers; and being adjusted to the keel with suitable scarfs, it serves to strengthen the bottom of the ship.

KEEP, in ancient military history, a kind of strong tower, which was built in the centre of a castle or fort, to which the besieged retreated, and made their last efforts of defence. Of this description is the keep of Windsor Castle.

KEEPER *of the great seal*, is a lord by virtue of his office, and styled the lord keeper of the great seal of England. He is one of the king's privy council, through whose hands pass all charters, commissions, and grants of the king under the great seal; without which, all such instruments by law are of no force,

Keeper *of the privy seal*, is a lord by virtue of his office, through whose hands pass all charters signed by the king before they come to the great seal. He is of the king's privy council.

KEEPING, in painting, signifies the representation of objects in the same manner that they appear to the eye at different distances from it, which is only to be done with accuracy by attending to the rules of perspective.

KELP, an impure alkali, obtained in the north of Scotland, from different kinds of fuci, or sea weed. The weeds being dried, are burned in pits dug in the sand, or on the surface, surrounded with loose stone, fresh quantities being added, and the whole being frequently stirred until it becomes semi-fluid, which, when cold, forms hard masses. About twenty-four tons of the weed are requisite to produce one ton of kelp. Kelp is usually employed in making soap; for this purpose saturated solution is obtained by hot water; the refuse, after this operation, is used in the manufacture of bottle glass.

KERMES. See Coccus.

Kermes *Mineral.* Sulphuretted hydrogen forms, with the deutoxide of antimony, a compound which possessed at one time great celebrity in medicine, and of which a modification has lately been introduced into the art of calico printing. By dropping hydrosulphuret of potash, or of ammonia, into the cream tartrate, or into mild muriate of antimony, the hydrosulphuret of the metallic oxide, precipitates of a beautiful deep orange colour. This is *kermes mineral.* Cluzel's process for obtaining a fine

subcarbonate of soda, and 200 parts of water, are to be boiled together in an iron pot. Filter the hot liquor into warm earthen pans, and allow them to cool very slowly. At the end of 24 hours the kermes is deposited. Throw it on a filter, wash it with water which had been boiled and then cooled out of contact with air. Dry the kermes at a temperature of 85°, and preserve it in corked phials.

KETCH, a vessel equipped with two masts, viz. the main-mast and the mizen-mast, and usually from 100 to 250 tons burthen. Ketches are principally used as yachts for conveying princes of the blood, ambassadors, or other great personages, from one place to another. Ketches are likewise used as bomb-vessels.

Ketches, *bomb*, are built remarkably strong as being fitted with a greater number of riders than any other vessel of war.

KEY, a well known instrument for opening and shutting the locks of doors, chests, &c. See Lock.

Key, or *key note*, in music a certain fundamental note or tone, to which the whole of a movement has a certain relation or bearing, to which all its modulations are referred and accommodated, and in which it both begins and ends. There are but two species of keys: one of the major, and one of the minor mode: all the keys in which we employ sharps or flats being deduced from the natural keys of C major and A minor; of which they are mere transpositions.

KIDNAPPING, is the forcible taking and carrying away a man, woman, or child, from their own country, and sending them to another, This is an offence at common law, and punishable by fine, imprisonment, and pillory.

By stat. 11 and 12 W. III. c. 7, if any captain of a merchant vessel shall, during his being abroad, force any person on shore, and wilfully leave them behind, or refuse to bring home all such men as he carried out, if able and desirous to return, he shall suffer three months' imprisonment. Exclusive of the above punishment for this as a criminal offence, the party may recover upon an action for compensation in damages for the civil injury.

KIDNEYS. See Anatomy.

KIFFEKIL. See Meerschaum.

KIGGELARIA, a genus of the decandria order, in the diœcia class of plants, and in the natural method ranking under the 37th order, columniferæ. There is but one species, viz. the Africana.

KILDERKIN, a liquid measure containing two firkins, or 18 gallons.

KING, signifies him who has the highest power and absolute rule over the whole land; and therefore the king is, in intendment of law cleared of those defects which common persons are subject to; for he is always supposed to be of full age, though ever so young. The law ascribes to his majesty, in his political capacity, an absolute immortality. The king never dies; for immediately on the decease of the reigning prince in his natural capacity, his imperial dignity, by act of law, without any interregnum or interval, is vested at once in his heir, who is eo instanti king to all intents and purposes And so tender is the law of supposing even a possibility of his death, that his natural dissolution is generally called his demise, an expres-

sons marrying papists, are for ever excluded from the imperial crown of Great Britain; and in such case, the crown shall descend to such person being a protestant, as should have inherited the same, in case such papist, or person marrying a papist, was naturally dead.

King's-bench. The king's-bench is the supreme court of common law in the kingdom, and is so called, because the king used to sit there in person; it consists of a chief justice, and three puisne justices, who are by their office the sovereign conservators of the peace, and supreme coroners of the land. This court has a peculiar jurisdiction, not only over all capital offences, but also over all other misdemeanors of a public nature, tending either to a breach of the peace, or to oppression or faction, or any manner of misgovernment. It has a discretionary power of inflicting exemplary punishment on offenders, either

by fine, imprisonment, or other infamous punishment, as the nature of the crime, considered in all its circumstances, shall require. The jurisdiction of this court is so transcendant, that it keeps all inferior jurisdictions within the bounds of their authority, and it may either remove their proceedings to be determined here, or prohibit their progress below: it superintends all civil corporations in the kingdom; commands magistrates and others to do what their duty requires, in every case where there is no specific remedy; protects the liberty of the subject, by speedy and summary interposition; takes cognizance both of criminal and civil causes; the former in what is called the crown side, or crown office; the latter in the plea side of the court. This court has cognizance on the plea side of all actions of trespass, or other injury alleged to be committed *vi et armis*, of actions for forgery of deeds, maintenance, conspiracy, deceit, and actions on the case which allege any falsity or fraud. In proceedings in this court, the defendant is arrested for a supposed trespass, which in reality he has never committed; and being thus in the custody of the marshal of this court, the plaintiff is at liberty to proceed against him for any other personal injury, which surmise of being in the custody of the marshal, the defendant is not at liberty to dispute. This court is likewise a court of appeal, into which may be removed, by writ of error, all determinations of the court of common pleas, and of all inferior courts of record in England.

KNAPSACK, a rough leather or canvas bag, which is strapped to an infantry soldier's back when he marches, and which contains his necessaries. Square knapsacks are supposed to be most convenient. They should be made with a division to hold the shoes, blacking-balls, and brushes, separate from the linen.

KNAUTIA, a genus of the mongynia order, in the tetrandria class of plants, and in the natural method ranking under the 48th order, aggregate. There are four species, chiefly annuals of the Levant.

KNEE. See ANATOMY

KNEE, in a ship, a crooked piece of timber, bent like a knee, used to bind the beams and futtocks together, by being bolted fast into them both.

KNIGHT, properly signifies a person, who for his virtue and martial prowess, is by the king raised above the rank of a gentleman, into a higher class of dignity and honour. The ceremonies at the creation of knights have been various; the principal was a box on the ear, and a stroke with a sword on the shoulder; they put on him a shoulder belt, and a gilt sword, spurs, and other military accoutrements; after which, being armed as a knight, he was led to the church in great pomp. Camden describes the manner of making a knight-bachelor among us, which is the lowest, though the most ancient order of knighthood, to be thus: the person kneeling was gently struck on the shoulder by the prince, and accosted in these words, "rise," or "be a knight in the name of God."

KNIGHTS *of the shire*, or KNIGHTS *of parliament*, in the British polity, are two knights or gentlemen of estate, who are elected on the king's writ, by the freeholders of every county, to represent them in parliament. The qualification of a knight of the shire is to be possessed of £600 per ann. in a freehold estate.

KNOT, means the division of the log-line used at sea. These are usually seven fathoms or forty-two feet; they ought to be fifty feet, and then as many knots as the log-line runs out in half a minute, so many miles does the ship sail in an hour, supposing her to keep going at an equal rate.

KNOTS *of a rope*, among seamen, are distinguished into three kinds, viz. whole-knot, that made so with the lays of a rope that it cannot slip, serving for sheets, tacks, and stoppers: bow-link-knot, that so firmly made and fastened to the cringles of the sails, that they must break or the sail split before it slips; and sheep-shank-knot, that made by shortening a rope without cutting it.

KNOWLEDGE, is defined by Mr. Locke, to be the perception of the connection and agreement, or disagreement and repugnancy of our ideas.

KNOXIA, a genus of the class and order tetrandria monogynia. The corolla is one petalled, funnel-form; seeds two grooved. There is one species, an herb of Ceylon.

KORAN, or ALCORAN, the scripture or bible of the Mahometans; containing the revelations and doctrines of their pretended prophet.

That Mahomet was the author of the Koran is allowed both by Christians and the Mahometans themselves; only the latter are fully persuaded that it was revealed to him by the ministry of the angel Gabriel; whereas the former with more reason, think it all his own invention, assisted by one Sergius, a Christian monk.

The Koran is divided into 114 larger portions of very unequal length, which we call chapters, but the Arabians *sowar*, in the singular *sura;* a word rarely used on any other occasion, and properly signifying a row, or a regular series. These chapters are not, in the manuscript copies, distinguished by their numerical order, but by particular titles, which are sometimes taken from a particular subject treated of, or persons mentioned in them, usually from the first word of note. But the Koran is more usually divided into thirty sections only, each of twice the length of the former, and in like manner subdivided into four parts. These divisions are for the use of the readers of the Koran in the royal temples, or in the adjoining chapels, where the emperors and great men are interred.

After the title at the head of each chapter, except the ninth, is prefixed the formula, "In the name of the most merciful God," called by the Mahometans Bismallah, wherewith they constantly begin all their books and writings as the distinguishing mark of their religion.

The Koran is universally allowed to be written with the utmost elegance and purity of language, in the dialect of the tribe of Koreish the most noble and polite of all the Arabians, but with some mixture, though very rarely, of other dialects: and it is confessedly the standard of the Arabic tongue.

The general aim of the Koran was, to unite the professors of the three different religions then followed in Arabia, Idolaters, Jews, and

Christians, in the knowledge and worship of one God, under the sanction of certain laws, and the outward signs of ceremonies, partly of ancient and partly of novel institution, enforced by the consideration of rewards and punishments, both temporal and eternal, and to bring all to the obedience of Mahomet, as the prophet and ambassador of God, who was to establish the true religion on earth, and be acknowledged chief pontiff in spiritual matters. The chief point, therefore, inculcated in the Koran, is the unity of God, to restore which, the prophet confessed was the chief end of his mission. The rest is taken up in prescribing necessary laws and directions, frequent admonitions to moral and divine virtues, the worship and reverence of the Supreme Being, and resignation to his will.

So numerous are the commentaries on the Koran, that a catalogue of their bare titles would make a volume: we have a very elegant translation of it into English by Mr. Sale; who has added a preliminary discourse, with other occasional notes, which the curious may consult on this head.

KOUMISS. A vinous liquid, which the Tartars make by fermenting mare's milk. Something similar is prepared in Orkney and Shetland.

KUPFERNICKEL, is a sulphuret of nickel, and is generally compounded of nickel, arsenic, and sulphuret of iron.

KURTUS, in natural history, a genus of fishes of the order jugulares. Generic character; body carinated above and below and broad; back highly elevated, gill membrane, with two rays. It inhabits the seas of India. Its length is about ten inches, and its breadth four. Its colour, on the whole body, is that of silver foil, and its back is tinged with gold, and marked on its ridge with several black spots.

KYANITE. See Cyanite.

KYLLINGIA, in botany, a genus of the triandria monogynia class and order. Natural order of gramina. Cyperoideæ, Jussieu. Essential character, ament ovate or oblong, imbricate; flowers with a bivalve calyx and corolla. There are seven species, natives of the East and West Indies.

L.

L, or *l*, the eleventh letter of the English alphabet, denotes as a numeral, 50; and with a dash over it thus $\bar{L}$, 50,000.

LA, in music, the syllable by which Guido denoted the last sound of each hexachord: if it begins in C, it answers to our A; if in G to E; and if in F to D.

LABARUM, in Roman antiquity, the standard borne before the Roman emperors; being a rich purple streamer, supported by a spear.

LABDANUM, or Ladanum. A resin of a species of cistus in Candia, of a blackish colour. The country people collect it by means of a staff, at the end of which are fastened many leather thongs, which they gently strike on the trees. They form it into cylindrical pieces; which are called *labdanum in tortis*. It is greatly adulterated by the addition of black sand. It has been used in cephalic and stomachic plasters and perfumes.

LABORATORY, signifies a place properly fitted up for the performance of chemical operations. Having referred the reader in several instances to this article for an account of different articles of chemical apparatus, which could not be so well described apart from each other, we shall here give the subject its full proportion of attention.

To attempt to offer the plan of a laboratory, which would be suitable to every person, and to all situations, would be highly preposterous; we shall therefore content ourselves with noticing a few leading particulars, at the same time remarking, that the experimentalist will soon discover that by a judicious combination of the following apparatus, a very extensive series of operations may be carried on.

It may be proper to notice here, for the sake of those who, in fitting up a laboratory, have it in their power to choose the situation of it, that a ground floor ought never to be chosen, unless it can be effectually secured from the effects of damp, which have always a most pernicious influence on many of the substances constantly in use in a chemical laboratory.

A laboratory, therefore, is more advantageously placed above than below the ground, that it may be as dry as possible. The air must have free access to it; and it must even be so constructed, that by means of two or more opposite openings, a current of air may be admitted, to carry off any noxious vapours or dust.

In the laboratory a chimney ought to be constructed, so high that a person may easily stand under it, and as extensive as is possible; that is, from one wall to another. The funnel of this chimney ought to be high, and sufficiently contracted to make a good draught. As charcoal only is burnt under this chimney, no soot is collected in it; and therefore it need not be so wide as to allow a chimney-sweeper to pass up into it.

Under this chimney may be constructed some brick furnaces, particularly a melting furnace, a furnace for distilling with an alembic, and one or two ovens like those in kitchens. The rest of the space ought to be filled up with stands of different heights, from a foot to a foot and a half, on which portable furnaces of all kinds are to be placed. These furnaces are the most convenient, from the facility of disposing them at pleasure; and they are the only furnaces which are necessary in a small laboratory. A double pair of bellows of a moderate size must also be placed as commodiously under the chimney, or as near as the place will allow. These bellows are sometimes mounted in a portable frame; which is sufficiently convenient when the bellows are not more than eighteen or twenty inches long. These bellows ought to have a pipe directed toward the hearth where the forge is to be placed.

The necessary furnaces are, the simple furnace, for distilling with a copper alembic; a

lamp furnace; two reverberatory furnaces of different sizes, for distilling with retorts; an air or melting furnace, an assay furnace, and a forge furnace.

Under the chimney, at a convenient height, must be a row of hooks driven into the back and side walls; upon which are to be hung small articles, as iron pans, tongs, straight, crooked, and circular pincers, pokers, &c. To the walls of the laboratory ought to be fastened shelves of different breadths and heights; or these shelves may be suspended by hooks. The shelves are to contain glass vessels, and the products of operations, and ought to be in as great a number as is possible. In a laboratory where many experiments are made, there cannot be too many shelves. The most convenient place for a stone or leaden cistern, to contain water, is a corner of the laboratory, and under it a sink ought to be placed with a pipe, by which the water poured into it may discharge itself. As the vessels are always cleaned under this cistern, cloths and bottle brushes ought to be hung upon hooks fastened in the walls near it.

In the middle of the laboratory a large table is to be placed, on which mixtures are to be made, preparations for operations, solutions, precipitations, small filtrations; in a word, whatever does not require fire, excepting that of a lamp.

In convenient parts of the laboratory are to be placed blocks of wood upon mats; one of which is to support a middle-sized iron mortar, another to support a middle sized marble, or rather hard stone mortar; a third to support an anvil. Near the mortars are to be hung searces of different sizes and fineness; and near the anvil a hammer, files, rasps, small pincers, scissars, sheers, and other small utensils, necessary to give metals a proper form for the several operations.

Two moveable trestles ought to be in a laboratory, which may serve to support a large filter mounted upon a frame, when it is required. This apparatus is removed occasionally to the most convenient place.

Charcoal is an important article in a laboratory, and it therefore must be placed within reach; but as the black dust which flies about it whenever it is stirred, is apt to soil every thing in the laboratory, it had better be in some place near the laboratory, together with some furze, which is very convenient for kindling fires quickly. This place serves, at the same time, for containing bulky things which are not often wanted: such as furnaces, bricks, tiles, clay, fire-clay, quicklime, sand, and many other things necessary for chemical operations.

Lastly, a middle-sized table, with solid feet, ought to be enumerated among the large moveables of a laboratory, the use of which is to support a porphyry, or levigating stone, or rather a very hard and dense gritstone, together with a muller made of the same kind of stone.

The other small moveables or utensils of a laboratory are, small hand mortars of iron, glass, agate, and Wedgewood's ware, and their pestles; earthern, stone, metal, and glass vessels, of different kinds, funnels, and measures. Some white writing paper, and some unsized paper for filters; a large number of clean straws, eight or ten inches long, for stirring mixtures in glasses, and for supporting paper filters placed in glass funnels. Glass tubes for stirring and mixing corrosive liquors; spatulas of wood, ivory, metal, and glass.

Thin pasteboards and horns, very convenient for collecting matters bruised with water upon the levigating stone, or in mortars; corks of all sizes; bladders and linen strips for luting vessels.

A good portable pair of bellows; a good steel for striking fire; a glue-pot, with its little brush; lastly, a great many boxes, of various sizes, for containing most of the above-mentioned things, and which are to be placed upon the shelves.

Besides the above, there are many substances which the operator must be possessed of, and which, indeed, may be considered as part of his instruments; these substances are called reagents. The plate annexed, with the following explanation of the different articles there delineated, will give the student an idea of the most useful parts of modern chemical apparatus.

Figures, 1, 2, 3, plate XXV. are crucibles or pots, made either of fire-clay, black lead, forged iron, or platina. They are used for roasting, calcination, and fusion

Figs. 4, 5, 6, are cucurbits, matrasses, or bodies, which are glass, earthenware, or metallic vessels, usually shaped like an egg, and open at top. They serve the purposes of digestion, evaporation, &c.

Retorts are globular vessels of earthern ware, glass, or metal, with a neck bended on one side. Some retorts have another neck or opening at their upper part, through which they may be charged, and the opening may be afterwards closed with a stopple. These are called tubulated retorts. A Welter's tube of safety may be inserted in this opening, instead of a stopple. See fig. 7, 8, *b*, *c*.

Receivers are vessels, usually of glass, of a spherical form, with a straight neck, into which the neck of the retort is usually inserted. When any proper substance is put into a retort, and heated, its volatile parts pass over into the receiver, where they are condensed. See fig. 9.

Fig. 10. The alembic is used for distillation, when the products are too volatile to admit of the use of the last mentioned apparatus. The alembic consists of a body *a*, to which is adapted a head *b*. The head is of a conical figure, and has its external circumference or base depressed lower than its neck, so that the vapours which rise, and are condensed against its sides, run down into the circular channel formed by its depressed part, from whence they are conveyed by the nose or beak *c*, into the receiver *d*.

Frequently, however, the flame of an Argand lamp may be employed very conveniently for chemical purposes. Fig. 11, is a representation of a lamp furnace, as it is perhaps not very properly called, as improved by Mr. Accum. It consists of a brass rod screwed to a foot of the same metal, loaded with lead. On this rod, which may be unscrewed in the middle for rendering it more portable, slide three brass sockets with straight arms, terminating in brass rings of different diameters. These rings serve for supporting glass alembics, retorts, Florence flasks, evaporating basins, gas bottles, &c.; for performing distillations, digestions solutions evaporations, saline fusions, concentrations,

analyses with the pneumatic apparatus, &c. If the vessels require not to be exposed to the naked fire, a copper sand bath may be interposed, which is to be previously placed in the ring. By means of a thumb-screw acting on the rod of the lamp, each of the brass rings may be set at different heights, or turned aside, according to the pleasure of the operator. Below these rings is a fountain lamp on Argand's plan, having a metallic valve within, to prevent the oil from running out while the reservoir is put into its place. This lamp also slides on the main brass rod by means of a socket and thumb-screw.

For experiments on gases, the following apparatus called the pneumatic trough, will be found exceedingly useful. It may be made of wood, or japanned iron, or of copper, and of any form that suits the conveniency of the chemist.

Fig. 12, *a* represents a wooden vessel or tub; *k k k*, is a shelf fixed in the tub. When this apparatus is used, the tub is to be filled with water to such a height, as to rise about one inch above the upper surface of the shelf. *b, g, f*, are glass jars inverted with their mouths downward, which rest upon the shelf. If these, or any other vessels open only at one end, be plunged under the water, and inverted after they are filled, they will remain full, notwithstanding their being raised out of the water, provided their mouths be kept immersed; for in this case the water is sustained by the pressure of the atmosphere, in the same manner as the mercury in the barometer. It may without difficulty be imagined, that if common air, or any other fluid resembling common air in lightness and elasticity, be suffered to enter these vessels, it will rise to the upper part, and the surface of the water will subside. In this manner air may be emptied out of one vessel into another by an inverted pouring, in which the air is made to ascend from the lower vessel *i* to the upper *g*, in which the experiments are performed by the action of the weightier fluid, exactly similar to the common pouring of denser fluids detained in the bottoms of open vessels, by the simple action of gravity. When the receiving vessel has a narrow neck, the air may be poured through a glass funnel *h*. *c* is a glass body or bottle, the bottom of which is blown very thin, that it may support the heat of a candle suddenly applied, without cracking. In its neck is fitted, by grinding, a tube *d*, curved neatly in the form of the letter *s*. This kind of vessel is very useful in various chemical operations, for which it will be convenient to have them of several sizes. In the figure, the body *c* is represented as containing a fluid, in the act of combining with a substance that gives out air, which passes through the tube into the jar *b*, under the mouth of which the other extremity of the tube is placed. At *e* is a small retort of glass or earthern ware, the neck of which being plunged in the water, beneath the jar *f*, is supposed to emit the elastic fluid, extricated from the contents of the retort, which is received in the jar.

When any thing, as a gallipot, is to be supported at a considerable height within a jar, it is convenient to have such wire-stands as are represented fig. 13

In order to expel air from solid substances by means of heat, a gun-barrel, with the touch-hole screwed up and rivetted, may be used instead of an iron retort. The subject may be placed in the chamber of the barrel, and the rest of the bore may be filled with dry sand, that has been well burned, to expel whatever air it might have contained. The stem of a tobacco-pipe, or a small glass tube, being luted in the orifice of the barrel, the other extremity must be put into the fire, that the heat may expel the air from its contents. This air will of course pass through the tube, and may be received under an inverted vessel, in the usual manner.

But the most accurate method of procuring air from several substances, by means of heat, is to put them, if they will bear it, into phials full of quicksilver, with the mouths inverted in the same, and then throw the focus of a burning lens or mirror upon them.

Many kinds of air combine with water, and therefore require to be treated in an apparatus in which quicksilver is made use of. This fluid being very ponderous and of considerable price, it is an object of convenience, as well as economy, that the trough and vessels should be smaller than when water is used. See plate XXVI. Fig. 6.

It is sometimes desirable to impregnate water for medicinal purposes with some gas, as the carbonic acid, and for this the apparatus of Dr. Nooth is very effectual and convenient. It consists of three glass vessels, plate XXIV. fig. 4. The lower vessel *c* contains the effervescent materials; it has a small orifice at *d*, stopped with a ground stopper, at which an additional supply of either acid, or water, or chalk, may be occasionally introduced. The middle vessel *b* is open, both above and below. Its inferior neck is fitted, by grinding, into the neck *h* of the lower vessel. In the former is a glass valve, formed by two pieces of tube, and a plano-convex lens, which is moveable between them. This valve opens upwards, and suffers the air to pass; but the water cannot run through the tubes. The middle vessel is furnished with a cock *e*, to draw off its contents. The upper vessel *a* is fitted, by grinding, into the upper neck of the middle vessel. Its inferior part consists of a tube that passes almost as low as the centre of the middle vessel. Its upper orifice is closed by a ground stopper *f*. When this apparatus is to be used, the effervescent materials are put into the lower vessel; the middle vessel is filled with pure water, and put into its place; and the upper vessel is stopped, and likewise put in its place. The consequence is, that the carbonic acid gas, passing through the valve at *h*, ascends into the upper part of the middle vessel *b*, where, by its elasticity, it reacts on the water, and forces part up the tube into the vessel *a*; part of the common air, in this last, being compressed, and the rest escaping by the stopper, which is made of a conical figure, that it may be easily raised. As more carbonic acid is extricated, more water rises, till at length the water in the middle vessel falls below the lower orifice of the tube. The gas then passes through the tube into the upper vessel, and expels more of the common air by raising the stopper. In this situation the water in both vessels being in contact with body of carbonic acid gas, it becomes strongly impregnated with this gas, after a certain time.

Sometimes it is requisite to obtain separately the condensable fluid that comes over, and the gases that are, and are not soluble in water. For this purpose a series of receivers, more or less in number as the case may require, is generally employed, as in plate XXV. fig. 1, which represents what is called Woolfe's apparatus, though in fact its original inventor was Glauber, with some subsequent improvements. The vapour that issues from the retort being condensed in the receiver *a*, the gas passes on through a bent tube into the bottle *c*, which is half filled with water. The gas not absorbed by this water, passes through a similar bent tube to *d*, and so on to more, if it be thought necessary; while the gas that is not absorbed by water, or condensable, at its exit from the last bottle is conveyed by a recurved tube into a jar *g*, standing in a mercurial trough *f f*.

A very simple and commodious form of a Woolfe's apparatus is given by the late Dr. W. Hamilton, at the end of his translation of Berthollet on Dyeing; see pl. XXIV fig. 1: *a*. is the retort, the neck of which is ground into and passed through the thick collar *b*, represented separately at *b*: with its ground stopple *a* which may be put in when the neck of the retort is withdrawn. The collar *b* is ground into the wide neck of the receiver *c*, the narrow neck of which is ground into the wide neck of *d*. *d*, *e*, *f*, and *g*, are connected in a similar manner; and into the small necks of *d*, *e*, and *f*, are ground the tubes *i*, *k*, and *l*, so curved, that their lower extremities nearly reach the bottom of the receiver into which they open. From the last receiver proceeds the recurved tube *m*, opening under an inverted cup *n*, a hole in the bottom of which conveys the gas issuing from it into one of the bottles placed in the moveable frame *p*, which has a heavy leaden foot to keep it steady in the centre of a flat pan of water, in which the mouths of the bottles are immersed. In the receiver *d* is a tube of safety *h*. The receivers are placed on a stand a little inclined, and kept steady by slips of wood hollowed out to fit their curvatures, as represented at *s s*. This apparatus requires no lute; has no bent tubes that are difficult to adjust, and liable to break; and the retort may be removed at any stage of the process, either to find the weight it has lost, or for any other purpose, the receiver being meanwhile closed with the stopple.

Fig. 3 represents the different parts of the apparatus required for measuring the quantity of elastic fluid given out during the action of an acid on calcareous soils. The bottle for containing the soil is represented at *a*; *b* the bottle containing the acid, furnished with a stop-cock; *c* the tube connected with a flaccid bladder *d*; *f* a graduated measure; *e* the bottle for containing the bladder. When this instrument is used, a given quantity of soil is introduced into *a*: *b* is filled with muriatic acid, diluted with an equal quantity of water; and the stop-cock, being closed, is connected with the upper orifice of *a*, which is ground to receive it. The tube *c* is introduced into the lower orifice of *a*, and the bladder connected with it placed in its flaccid state in *e*, which is filled with water. The graduated measure is placed under the tube of *e*. When the stop-cock of *b* is turned, the acid flows into *a*, and acts upon the soil; the elastic fluid generated passes through *c* into the bladder, and displaces a quantity of water in *e*, equal to it in bulk; and this water flows through the tube into the graduated measure, the water in which gives, by its volume, the indication of the proportion of carbonic acid disengaged from the soil.

In chemical experiments the blow-pipe is of essential utility. This instrument is now variously constructed. The blow-pipe for philosophical purposes is provided with a bowl, or enlargement. *a*, fig. 7, in which the vapours of the breath are condensed and detained; and also with three or four small nozzles, *b*, with different apertures, to be slipped on the smaller extremity.

A wax candle, of a moderate size, but thicker wick than they are usually made with, is the most convenient for occasional experiments; but a tallow candle will do very well. The candle should be snuffed rather short, and the wick turned on one side toward the object, so that a part of it should lie horizontally. The stream of air must be blown along this horizontal part, as near as may be without striking the wick. When the hole is of a proper figure, and duly proportioned, the flame consists of a neat luminous blue cone, surrounded by another flame of a more faint and indistinct appearance. The strongest heat is at the point of the inner flame.

The body intended to be acted on by the blow-pipe, ought not to exceed the size of a peppercorn. It may be laid upon a piece of close-grained, well-burned charcoal unless it be of such a nature as to sink into the pores of this substance, or to have its properties affected by its inflammable quality. Such bodies may be placed in a small spoon made of pure gold, or silver, or platina.

A very ingenious contrivance by Mr. Hooke, sometimes called the self-acting blow-pipe, is represented, plate XXIV. fig. 15. Here, *a* is a hollow sphere for containing alcohol, resting upon a shoulder in the ring *o*. If the bottom be made flat instead of spherical, the action of the flame will then be greater. *b* is a bent tube with a jet at the end, to convey the alcohol in the state of a vapour into the flame at *q*. This tube is continued in the inside up to *c*, which admits of *a* being filled nearly, without any alcohol running over. *d* is a safety valve, the pressure of which is determined at pleasure, by screwing higher or lower on the pillar , the two milled nuts *f* and *g* carrying the steel arm *h*, which rests on the valve. *i* is an opening for putting in the alcohol. *k* is the lamp. which adjusts to different distances from *a*, by sliding up or down the two pillars *l l*. The distance of the flame *q* from the jet is regulated by the pipe which holds the wick being a little removed from the centre of the brass piece *m*, and of course revolving in a circle. *n* the mahogany stand.

The greatest improvement, however, that this instrument has undergone, was introduced by Mr. Gurney, in his lectures delivered at the Surrey Institution, of which a full account may be seen in the published volume.

For distillation on a small scale, the retort or the alembic may be employed; but for many purposes it is necessary to use a still constructed on the principle of those which are made of the largest dimensions.

Fig. 16 represents the large stills used in the distillation of ardent spirits. *a* represents the body, and *b* the head, as before. Instead of using a refrigeratory or receiver, the spirit is made to pass through a spiral pipe called the worm, which is immersed in a tub of cold water *d*. During its passage it is condensed, and comes out at the lower extremity *e*, of the pipe, in a fluid form.

An indispensable article of apparatus in the laboratory is the gasometer, which enables the operator to receive and preserve large quantities of gas, with the aid of only a few pounds of water. Gasometers are made of different forms; but one of the most simple and most convenient, is shewn in fig. 4. plate XXV. It consists of an outer fixed vessel, *d*, and an inner fixed one, *c*, both of japanned iron. The inner vessel slides easily up and down within the outer, and is suspended by cords passing over pullies: to which are attached the counterpoises *e e*. To avoid the inconvenience of a great weight of water, the outer vessel is made double, or is composed of two cylinders, the inner of which is closed at the top and at the bottom.

The space only of about half an inch is left between the two cylinders as shown by the dotted lines. In this space the vessel *c*, may move freely up and down. The interval is filled with water as high as the top of the inner cylinder. The cup or rim on the top of the outer vessel, is to prevent the water from overflowing when the vessel *c* is forcibly pressed down, in which situation it is placed whenever gas is about to be collected. The gas enters from the vessel in which it is produced by the communicating opening *b*, and passes along the perpendicular pipe marked by dotted lines in the centre into the cavity of the vessel *c*, which continues rising till it is full.

To transfer the gas, or to apply it to any purpose, the cock *b* is to be shut, and an empty bladder, or bottle of elastic gum, furnished with a stop cock, is to be screwed on *a*. When the vessel *c* is pressed down by the hand, the gas passes down the central pipe, which it had before ascended, and its escape at *b* being prevented, it finds its way up a pipe which is fixed on the outer surface of the vessel, and which is terminated by the cock *a*. By means of an ivory mouth-piece screwed on this cock, the gas included in the instrument may be respired; the nostrils being closed by the fingers. When it is required to transfer the gas into glass jars standing in water, a crooked tube may be employed, one end of which is screwed upon the cock, *b*, while the other aperture is brought under the inverted funnel, fixed into the shelf of the pneumatic trough. The counterpoises *e e*, are generally concealed in the framing, and the vessel *c* is frequently made of glass.

When large quantities of gas are required (as at a public lecture) the gas holder, fig. 5. will be found extremely useful. It is made of tinned iron plate, japanned both within and without. Two short pipes, *a* and *c*, terminated by cocks, proceed from its sides, and another, *b*, passes through the middle of the top or cover, to which it is soldered, and reaches within half an inch of the bottom.

It will be found convenient also to have an air cock with a very wide bore fixed to the funnel at *b*. When gas is to be transferred into this vessel from the gasometer, the vessel is first completely filled with water through the funnel, the cock *a* being left open and *c* shut. By means of an horizontal pipe, the aperture *a* is connected with *a* of the gasometer. The cock *b* being shut, *a* and *c* are opened, and the vessel *c* of the gasometer, fig. 8, gently pressed downwards with the hand. The gas then descends from the gasometer till the air holder is full; which may be known by the water ceasing to escape through the cock *c*. All the cocks are then to be shut, and the vessels disunited. To apply this gas to any purpose, an empty bladder may be screwed on *a*. And water being poured through the funnel *b*, a corresponding quantity of gas is forced into the bladder. By lengthening the pipe *b*, the pressure of a column of water may be added; and the gas being forced through *a*, with considerable velocity, may be applied to the purpose of a blow-pipe, &c. &c.

Fig. 8 represents the combustion of iron-wire in oxygen gas. If a fine iron-wire, *a*, twisted in the form of a cork screw, having an ignited sulphur match attached to it, be plunged into a jar of oxygen gas, *b*, a most brilliant and rapid scintillating combustion takes place, forming oxide of iron. In this process, such is the greatness of the heat, that the small globules of the melted metal often penetrate the sides of the jar, if permitted to strike against them.

We shall conclude this article with a remark or two respecting furnaces, which, perhaps, would have been better introduced before; but it is hoped that this circumstance will be viewed as of minor importance.

The best construction of a furnace has not been well ascertained from experience. There are facts which shew, that a fire made on a grate near the bottom of a chimney, of equal width throughout, and open both above and below, will produce a more intense heat than any other furnace. What may be the limits for the height of the chimney is not ascertained from any precise trials; but thirty times its diameter would not probably be too high. It seems to be an advantage to contract the diameter of a chimney, so as to make it smaller than that of the fire-place, when no other air is to go up the chimney than what has passed through the fire; and there is no prospect of advantage to be derived from widening it.

Fig. 9 exhibits the wind or air furnace for melting. *a* is the ash-hole, *f* an opening for the air. *c* is the fire-place, containing a covered crucible, standing on a support of baked earth, which rests on the grate; *d* is the passage into *e*, the chimney. At *d* a shallow crucible or cupel may be placed in the current of the flame, and at *x* is an earthen or stone cover, to be occasionally taken off for the purpose of supplying the fire with fuel.

Fig. 10 is [illegible] reverberatory furnace [illegible] the ash-pit and fire place. *b b* body of the furnace. *c c* dome, or reverberating roof of the furnace. *d d* chimney. *e e* door of the ash-pit. *f f* door of the fire-place. *g g* handles of the body. *h* aperture to admit the head of the retort. *i i* handles of the dome. *k* receiver *l l* stand of the receiver. *m m* retort, represented in the body by dotted lines.

M. Chenevix has constructed a wind furnace, which is in some respects to be preferred to the usual form. The sides, instead of being perpendicular, are inverted, so that the hollow space is pyramidical. At the bottom the opening is 13 inches square, and at the top but eight. The perpendicular height is 17 inches. This form appears to unite the following advantages:—1st, A great surface is exposed to the air, which, having an easy entrance, rushes through the fuel with great rapidity; 2d, The inclined sides act in some measure as reverberating surfaces; and 3d, The fuel falls of itself, and is always in close contact with the crucible placed near the grate. The late Dr. Kennedy of Edinburgh, whose opinion on this subject claims the greatest weight, found that the strongest heat in our common wind furnaces was within two or three inches of the grate. This, therefore, is the most advantageous position for the crucible, and still more so when we can keep it surrounded with fuel. It is inconvenient and dangerous for the crucible, to stir the fire often to make the fuel fall, and the pyramidical form renders this unnecessary.

Many other articles of apparatus might have been here enumerated; but if the student find the above insufficient for his purpose, let him consult those works which treat exclusively on chemistry. We shall only here add that no laboratory can be complete without a very powerful electrical machine, and a good double barrelled air-pump.

Laboratory, signifies also in military affairs, that place where all sorts of fire-works are prepared both for actual service, and for pleasure.

LABOUR, in general, denotes a close application to work or business. Among seamen a ship is said to be in labour when she rolls and tumbles very much, either a hull under sail, or at anchor. It is also spoke of a woman in travail, or child-birth.

LABOURER. See Master and Servant.

LABRADOR *stone*. See Felspar.

LABYRINTH, in gardening, a winding mazy walk between hedges, through a wood or wilderness. The chief aim is to make the walks so perplexed and intricate, that a person may lose himself in them, and meet with as great a number of disappointments as possible. They are rarely to be met with, except in great gardens, as Versailles, Hampton-court, &c.

The few celebrated labyrinths of the ancients were those of Crete, Egypt, Lemnos, and Italy.

LAC is a substance well known in Europe, under the different appellations of stick-lac, shell-lac, and seed-lac. The first is the lac in its natural state, encrusting small branches or twigs. Seed-lac is the stick-lac separated from the twigs, appearing in a granulated form, and probably deprived of part of its colouring matter by boiling. Shell-lac is the substance which has undergone a simple purification, as mentioned below. Besides these we sometimes meet with a fourth, called lump-lac, which is the seed-lac melted and formed into cakes.

Lac is the product of the coccus lacca, which deposits its eggs on the branches of a tree called Bihar, in Assam, a country bordering on Thibet, and elsewhere in India. It appears designed to answer the purpose of defending the eggs from injury, and affording food for the maggot in a more advanced state. It is formed into cells, finished with as much art and regularity as a honeycomb, but differently arranged; and the inhabitants collect it twice a-year, in the months of February and August.

For the purification, it is broken into small pieces, and put into a canvass bag of about four feet long, and not above six inches in circumference. In India, lac is fashioned into rings, beads, and other trinkets; sealing-wax, varnishes, and lakes for painters, are made from it; it is much used as a red dye, and wool tinged with it is employed as a fucus by the ladies; and the resinous part, melted and mixed with about thrice its weight of finely powdered sand, forms polishing stones. The lapidaries mix powder of corundum with it in a similar manner.

LACCIC *acid*, in chemistry, a white or yellowish production of insects, called white-lac. Some of this substance, brought from Madras, was analyzed by Dr. Pearson, who found that it bore a considerable analogy to bees wax. The component parts of this acid are supposed to be carbon, hydrogen, and oxygen.

LACE, in commerce, a work composed of many threads of gold, silver, or silk, interwoven one with the other, and worked upon a pillow with spindles, according to the pattern designed; the open work being formed with pins, which are placed and displaced as the spindles are moved.

Method of cleaning gold-lace and embroidery when tarnished.—For this purpose alkaline liquors are by no means to be used; for while they clean the gold they corrode the silk, and change or discharge its colour. Soap also alters the shade, and even the species of certain colours. But spirit of wine may be used without any danger of its injuring either the colour or quality of the subject; and in many cases proves as effectual for restoring the lustre of the gold as the corrosive detergents.

Lace, *bone*, a lace made on fine linen thread or silk, much in the same manner as that of gold and silver. The pattern of the lace is fixed upon a large round pillow, and pins being stuck into the holes or openings in the pattern, the threads are interwoven by means of a number of bobbins, made of bone or ivory, each of which contains a small quantity of fine thread, in such a manner as to make the lace exactly resemble the pattern.

LACERTA, *lizard*, a genus of the amphibia class, and of the order of reptiles; the generic character is, body four-footed, elongated, tailed; without any secondary integument. Of this genus there are reckoned about eighty species, of which we can here notice only a few of the most remarkable:

1. *Lacerta crocodilus*, or crocodile. The crocodile, so remarkable for its size and powers of destruction, is a native of Asia and Africa, but seems to be most common in the latter; inhabiting large rivers, as the Nile, the Niger, &c. and preying principally on fish, but occasionally seizing on almost every animal which happens to be exposed to its rapacity. The size to which the crocodile sometimes arrives is prodigious: specimens being frequently

seen of 20 feet in length, and instances are commemorated of some which have exceeded the length of 30 feet. The armour with which the upper part of the body is covered may be numbered among the most elaborate pieces of nature's mechanism. In the full grown animal it is so strong and thick as easily to repel a musket-ball; on the lower parts it is much thinner, and of a more pliable nature: the whole animal appears as if covered with the most regular and curious carved work; the colour of a full grown crocodile is blackish-brown above, and yellowish-white beneath; the upper parts of the legs and the sides varied with deep yellow, and in some parts tinged with green.

The crocodile in a young state is by no means to be dreaded, its small size and weakness preventing it from being able to injure any of the larger animals: it therefore contents itself with fish and other small prey. The crocodile lies in wait near the banks, and snatches dogs and other animals, swallowing them instantly, and then plunging into the flood, and seeking some retired part, where it may lie concealed till hunger again invites it to its prey. In its manner of attack it is exactly imitated by the common lacerta palustris, or water-newt, which, though not more than four or five inches long, will with the greatest ease swallow an insect of more than an inch in length; and that at one single effort, and with a motion so quick, that the eye can scarcely follow it.

Crocodiles. like the rest of the lacertæ, are oviparous: they deposit their eggs in the sand or mud near or on the banks of the rivers they frequent, and the young when hatched immediately proceed to the water; but the major part are said to be devoured by other animals, as ichneumons, birds, &c. The eggs, as well as the flesh of the crocodile itself, are numbered among the delicacies of some of the African nations, and are said to form one of their favorite repasts.

2. *Lacerta alligator* so nearly resembles the crocodile, that many naturalists have been inclined to consider it as a mere variety, rather than a distinct species. The leading difference seems to be, that the head of the alligator is rather smooth on the upper part than marked with those very strong rugosities and hard carinated scales which appear on that of the crocodile; and that the snout is considerably flatter and wider, as well as more rounded at the extremity. The alligator arrives at a size not much inferior to that of the crocodile.

3. *Lacerta Gangetica.* The Gangetic crocodile is so strikingly distinguished both from the Nilotic and the alligator by the peculiar form of the mouth, that it is hardly possible, to confound it with either of the former; the jaws being remarkably long, narrow, and perfectly straight, and the upper mandible terminated above an elevated tubercle. The teeth are nearly double the number of those of the common crocodile, and are of equal size throughout the whole length of the jaws. This species is a native of India, and is principally seen in the Ganges.

4. *Lacerta iguana* is a native of many parts of America and the West Indian islands, and is also said to occur in some parts of the East Indies. Its general colour is green, but with much variation in the tinge of different individuals: it is generally shaded with brown in some parts of the body, and sometimes this is even the predominating colour. The back of the guana is very strongly serrated; and this, together with the gular pouch, which it has the power of extending or inflating occasionally to a great degree, gives a formidable appearance to an animal otherwise harmless. It inhabits rocky and woody places, and feeds on insects and vegetables. It is itself reckoned an excellent food, being extremely nourishing and delicate; but it is observed to disagree with some constitutions. The guana may be easily tamed while young, and is both an innocent and beautiful creature in that state.

5. *Lacerta basiliscus.* The basilisk of the ancients, supposed to be the most malignant of all poisonous animals, and of which the very aspect was said to be fatal, is a fabulous existence to be found only in the representations of painters and poets. But the animal known in modern natural history by this name is a species of lizard, of a very singular shape, and which is particularly distinguished by a long and broad wing-like process continued along the whole length of the back, and to a considerable distance on the upper part of the tail, and furnished at certain distances with internal radii analogous to those in the fins of fishes, and still more so to those in the wings of the draco volans, or flying lizard. Notwithstanding its formidable appearance the basilisk is a perfectly harmless animal, and, like many other of the lizard tribe, resides principally among trees, where it feeds on insects, &c.

6. *Lacerta chamæleon.* Few animals have been more celebrated by natural historians than the chameleon, which has been sometimes said to possess the power of changing its colour at pleasure, and of assimilating it to that of any particular object or situation. This, however, must be received with very great limitations; the change of colour which the animal exhibits varying in degree according to circumstances of health, temperature of the weather, and many other causes, and consisting chiefly in a sort of alteration of shades from the natural greenish or bluish grey of the skin into pale yellowish, with irregular spots or patches of dull red. The general length of the chameleon, from the tip of the nose to the beginning of the tail, is about ten inches, and the tail is of nearly similar length, but the animal is found of various sizes, and sometimes exceeds the length above mentioned. It is a creature of a harmless nature, and supports itself by feeding on insects; for which purpose the structure of the tongue is finely adapted, consisting of a long, missile body, furnished with a dilated and somewhat tubular tip, by means of which the animal seizes insects with great ease, darting out its tongue in the manner of a woodpecker, and retracting it instantaneously with the prey secured on its tip. It can also support a long abstinence, and hence arose the popular idea of the chameleon being nourished by air alone. It is found in many parts of the world, and particularly in India and Africa.

7. *Lacerta salamandra.* The salamander, so long the subject of popular error, and of which so many idle tales have been recited, is an inhabitant of many parts of Germany, Italy, France, &c. but does not appear to have been discovered in England. It delights in moist

and shady places, woods, &c. and is chiefly seen during a rainy season. In the winter it lies concealed in the hollows about the roots of old trees, in subterraneous recesses, or in the cavities of old walls, &c The idea of its being capable of enduring fire without injury, can be accounted for, merely from its possessing a power of exuding in any state of irritation a white and glutinous substance, which must of course tend to render the application of fire less immediately destructive to it than to some other animals, and considering what trifling causes have led, in innumerable cases to important inferences, this fact may probably have given rise to the notion of the salamander being insusceptible of destruction, and even of injury in the midst of flames. The idea of its poisoning any large animal by its bite is equally exploded. The salamander produces its young living, hatched from internal eggs, and frequently upwards of thirty in number.

8. *Lacerta vulgaris.* This, which is the smallest of the British lizards, is altogether a terrestrial species. It is commonly seen in gardens, and not unfrequently in the neighbourhood of dunghills, &c. It also occasionally makes its way into cellars in the manner of the slug, the toad, &c.

9. *Lacerta aquatica.* This, which in England occurs almost in every stagnant water, is a small species. Its general length is about three inches and a half, and it very rarely exceeds that of four inches at most. The water-newts are remarkable for a high degree of reproductive power, and have been known to exhibit the restoration of their legs, tails, and even, according to Dr. Blumenbach, of the eyes themselves, after having been deprived of them by cutting.

LACHES, in law, signifies slackness or negligence; as when we say, "there is a laches of entry," it means the same as to say, there is lack or neglect of entry.

LACHRYMAL, in anatomy, an appellation given to several parts of the eye, from their serving to secrete the tears. The lachrymal gland is situated in the orbit above the smaller angle, and its excretory ducts under the upper eye-lid.

LACK *of rupees*, is 100,000 rupees; which, supposing them standard, or siccas, at 2*s.* 6*d.* amounts to 12,500*l.* sterling.

LACQUERS, are varnishes applied upon tin, brass, and other metals, to preserve them from tarnishing, and to improve their colour. The basis of lacquers is a solution of the resinous substances called seed lac in spirit of wine. The spirit ought to be very much concentrated, in order to dissolve much of the lac. To a pint of the purified spirit, about three ounces of powdered shell-lac are to be added; and the mixture to be digested during the same day with a moderate heat. The liquor ought then to be poured off, strained, and cleared by settling. This clear liquor is now fit to receive the required colour from certain resinous colouring substances, the principal of which are gamboge and annotto; the former of which gives a yellow, and the latter an orange colour. In order to give a golden colour, two parts of gamboge are added to one of annotto; but these colouring substances may be separately dissolved in the tincture of lac, and the colour required may be adjusted by mixing the two solutions in different proportions. When silver leaf or tin is to be lacquered, a larger quantity of the colouring materials is requisite than when the lacquer is intended to be laid on brass.

LACTEAL *vessels*. See ANATOMY.

LACTIC *acid*. By evaporating sour whey to one-eighth, filtering, precipitating with lime water, and separating the lime by oxalic acid, Scheele obtained an aqueous solution of what he supposed to be a peculiar acid, which has accordingly been termed the *lactic*. To procure it separate, he evaporated the solution to the consistence of honey, poured on it alcohol, filtered this solution, and evaporated the alcohol. The residuum was an acid of a yellow colour, incapable of being crystallized, attracting the humidity of the air, and forming deliquescent salts with the earths and alkalis.

Bouillon Lagrange since examined it more narrowly; and from a series of experiments concluded, that it consists of acetic acid, muriate of potash, a small portion of iron probably dissolved in the acetic acid, and an animal matter.

This judgment of M. Lagrange was afterwards supported by the opinions of MM. Fourcroy and Vauquelin. But since then Berzelius has investigated its nature very fully, and has obtained, by means of a long and often repeated series of different experiments, a complete conviction that Scheele was in the right, and that the lactic acid is a peculiar acid, very distinct from all others. The extract which is obtained when dried whey is digested with alcohol, contains uncombined lactic acid, lactate of potash, muriate of potash, and a proper animal matter.

LACTUCA, the *lettuce*, a genus of the polygamia æqualis order, in the syngenesia class of plants, and in the natural method ranking under the 49th order, compositæ. There are 11 species, most of which are plants of no use, and never cultivated but in botanic gardens for variety. That commonly cultivated in the kitchen-garden is the sativa, which includes the following varieties: 1. The common or garden lettuce. 2. Cabbage lettuce. 3. Silesia lettuce. 4 Dutch brown lettuce. 5. Aleppo, or sperm lettuce. 6. Imperial lettuce. 7. Green capuchin lettuce. 8. Versailles, or upright white cos lettuce 9. Black cos. 10. Red cos. 11. Red capuchin lettuce. 12. Roman lettuce. 13. Prince lettuce. 14. Royal lettuce. 15. Egyptian cos lettuce.

LADDERS, *scaling*, in the military art, are used in scaling when a place is to be taken by surprise. They are made several ways. Sometimes of flat staves, so that they may move about their pins, and shut like a parallel ruler, for conveniently carrying them: the French make them of several pieces, so as to be joined together, and to be made of any necessary length: sometimes they are made of single ropes, knotted at proper distances, with iron hooks at each end, one to fasten them upon the wall above, and the other in the ground; and sometimes they are made with two ropes, and staves between them, to keep the ropes at a proper distance, and to tread upon. When they are used in the action of scaling walls, they ought to be rather too long than too short, and to be given in charge only to the stoutest of the detachment.

LADY'S *smock*. See CARDEMINE.

Lady's *slipper*. See Cypripedium.

LAETIA, a genus of the monogynia order, in the polyandria class of plants, and in the natural method ranking with those of which the order is doubtful. There are four species, natives of America. One of them, the apetala, or gum-wood, Dr. Wright informs us, is very common in the woodlands and copses of Jamaica, where it rises to a considerable height and thickness.

LAGOECIA, a genus of the monogynia order, in the pentandria class of plants. There is one species, wild cummin, an annual of the Levant.

LAGUNEA, a genus of the class and order monadelphia polyandria. There are three species, shrubs of the East Indies and Surinam.

LAGURUS, a genus of the digynia order, in the triandria class of plants, and in the natural method ranking under the fourth order gramina. There is one species, a grass of the south of Europe.

LAKE, a collection of waters contained in some cavity in an inland place, of a large extent, surrounded by land, and having no visible connexion with the ocean. Geographers divide lakes into four kinds. 1. Such as neither receive nor send forth rivers. 2. Such as send forth rivers, without receiving any. 3. Such as receive rivers without emitting any. And, 4. Such as both receive and send forth rivers. See Geography.

Lake, is a combination of colouring extract, with an earth, or metallic oxide, formed by precipitation from the solution of the colouring matter. If a solution of alum is added to an infusion of madder, a mutual decomposition takes place, and part of the alumine falls united with the colouring matter of the madder. Precipitates, of different shades of colour, are obtained with alum, nitre, chalk, acetate of lead, and muriate of tin. The lakes form some of the beautiful pigments, and are highly esteemed in water-colour painting.

LAMA, the sovereign pontiff, or rather god, of the Asiatic Tartars, inhabiting the country of Barantola. The Lama is not only adored by the inhabitants of the country, but also by the kings of Tartary, who send him rich presents, and go in pilgrimage to pay him adoration, calling him lama-congin, *i. e.* God the everlasting father of heaven. He is never to be seen but in a secret place of his palace, amidst a great number of lamps, sitting cross-legged upon a cushion, and adorned all over with gold and precious stones: where, at a distance, they prostrate themselves before him, it not being lawful for any to kiss even his feet.

LAMB. See Ovis.

LAMINÆ, the thin plates of which any thing consists: hence the epithet laminated, which is applied to those bodies, the texture of which discovers such a disposition as that of plates lying over one another.

LAMIUM, *dead-nettle*, a genus of the gymnospermia order, in the didynamia class of plants, and in the natural method ranking under the 42d order, verticillatæ. There are 13 species, of which only two, viz. the album, white archangel or dead-nettle, and the purpureum, or red archangel, deserve notice.

LAMP, a vessel containing oil, with a lighted wick; of which there is an indefinite number made of various constructions for various purposes. We shall particularly notice Argand's lamp. The principle on which the superiority of this lamp depends, is the admission of a larger quantity of air to the flame than can be done in the common way. This is accomplished by making the wick of a circular form, by which means the current of air rushes through the cylinder on which it is placed, and along with that which has access to the outside, excites the flame to such a degree that the smoke is entirely consumed. Thus, both the light and heat are much increased, at the same time that there is a considerable saving in the expence of oil, the consumption of the inflammable matter being exceedingly augmented by the quantity of air admitted to the flame; so that what in common lamps is dissipated in smoke is here converted into a brilliant flame. This lamp is now very much in use, and is consequently well known.

Various improvements have been made on the construction of Argand's lamp, but to the present hour the principle remains the same. Almost all the modern gas burners are on Argand's principle; and indeed the most splendid and costly modern lamps, whether French or English, give out their light from an Argand burner.

The chief improvement in the Argand lamp is, the method of raising and depressing the wick: this was formerly done by means of a rack and pinion, but these motions are now produced by means of a single tooth working in a spiral groove cut on the outside of a tube, within which is placed the wick, stretched tightly over a brass ring, or rather short tube, which is jagged to keep the wick tight.

We shall here notice a very curious, and what in many cases must be a very useful lamp, viz. a *lamp without flame*. To construct a lamp of this description, take a fine platinum wire, about $\frac{1}{100}$ of an inch in diameter; form with it about a dozen convolutions on a tobacco-pipe or a small black lead pencil: place this spiral on the tube of a common spirit lamp; let the lamp be half filled with spirit; light the wick, and when the coils of the wire become red-hot, blow out the flame, and all the wire above the wick will quickly become of a white heat, and continue to give out a very brilliant light as long as the alcohol lasts. The experiment, however, requires great delicacy to make it succeed.

Lamp-*black*. See Black.

LAMPREY. See Petromyzon.

LAMPYRIS, *glow-worm*, a genus of insects of the order coleoptera: the generic character is, antennæ filiform; wing-sheaths flexile; thorax flat, semiorbicular, concealing and surrounding the head; abdomen with the sides pleated into papillæ; female (in most species) wingless. The lampyris noctiluca, or common glow-worm, is a highly curious and interesting animal. It is seen during the summer months as late as the close of August, if the season is mild, on dry banks, about wood, pastures, and hedgeways, exhibiting, as soon as the dusk of the evening commences, the most vivid and beautiful phosphoric splendour, in form of a round spot of considerable size. The animal itself, which is the female insect, measures about three quarters of an inch in length, and is of a dull earthy brown colour on the upper parts, and beneath more or less tinged with

ose-colour, with the two or three last joints of the body of a pale or whitish sulphur colour. The glow-worm is a slow-moving insect, and in its manner of walking frequently seems to drag itself on by starts, or slight efforts.

LANA, in botany, *wool*, a species of pubescence, down, or velvet, which serves to screen the leaves, covered with it, from the heat: this appearance is very conspicuous in the horehound, woolly thistle, &c.

LANA *philosophica*, flowers of zinc. See ZINC.

LANCET, a chirurgical instrument, sharp-pointed, and two-edged, chiefly used for opening veins in the operation of phlebotomy, or bleeding; also for laying open abscesses, tumours, &c.

LAND, in the sea language, makes part of several compound terms: thus *land-laid*, or to lay the land, is just to lose sight of it. *Land-locked*, is when the land lies all round the ship, so that no point of the compass is open to the sea: if she is at anchor in such a place, she is said to ride land-locked, and is therefore concluded to ride safe from the violence of winds and tides. *Land-mark*, any mountain, rock, steeple, tree, &c. that may serve to make the land known at sea. *Land is shut in*, a term used to signify that another point of land hinders the sight of that the ship came from. *Land to*, or the ship lies land to, that is, she is so far from shore that it can only be just discerned. *Land-turn*, is a wind that in almost all hot countries blows at certain times from the shore in the night. *To set the land*, that is, to see by the compass how it bears.

LANDSCAPE. See PAINTING.

LANGUAGE, properly signifies the expression or enunciation of human thoughts and sentiments, by means of the articulate sounds of the human voice.

Man, of all animals, only is possessed of speech. Mere sound is, indeed, the sign of what is pleasurable or painful, and it is, for that reason, common to most other animals; for, in this manner, do they signify their feelings to each other. But speech indicates what is expedient or hurtful, and, a natural consequence, what is just or unjust. It is, therefore, given to man; for a sense of good and evil is peculiar to man alone.

The most intelligent of the brute creation frequently astonish us by actions, which can proceed only from powers of intellect, similar to our own: the capacity of speech then, is the criterion of distinction between man and the brute creation. Reason, the capital faculty and characteristic of man, would, without this extensive power of communication, have remained in inactivity, its energies unexcited, and its faculties torpid. The origin of written language is involved in great obscurity; nor has this obscurity been much lessened by the erudition that has been expended in the attempts of the learned to remove it. In the early ages of the world, there is every reason to suppose, that the difference of language in Europe, Asia, and Africa, was no more than a difference of dialects; and that the people of Greece, of Phœnicia, and of Egypt, mutually understood each other. The *oriental* origin of the Latin and Greek, is now generally acknowledged; and to these the Teutonic dialects have an affinity; the Arabic, the Chaldee, the Syriac, and the Ethiopic still bear the most striking resemblance to the *Hebrew*: in the Welsh, are many words analogous to it: the Celtic, also, has derived much from this and other eastern languages. The Hebrew, then, if we judge from these remarkable facts, from the mode of its derivation from its radicals, or from the simplicity of its structure must, undoubtedly, be considered as the primitive or parent language.

An eminent linguist of the present day thinks it very likely, that the original language was composed of monosyllables, that each had a distinct ideal meaning, and only one meaning; as different acceptations of the word would undoubtedly arise, either from compounding terms, or when there were but few words in the language, using them by a different mode of pronunciation, to express a variety of things. Where this simple, monosyllabic language prevailed, (and it must have prevailed in the first ages of the world,) men would necessarily have *simple ideas*, and a corresponding *simplicity of manners*. The Chinese language is exactly such as this; and the Hebrew, if stripped of its vowel points, and its prefixes, suffixes, and postfixes, separated from their combinations, so that they might stand by themselves, would nearly answer to this character, even in its present state.

LANIUS, the *shrike* or *butcher-bird*; a genus belonging to the order of accipitres; generic character, beak somewhat straight, with a tooth on each side towards the apex, and naked at the base; tongue lacerated.

1. The *excubitor*, great cinereous shrike, or greater butcher-bird, is in length ten inches. The plumage on the upper parts is of a pale ash-colour; the under, white; through the eyes there is a black stripe; the scapulars are white; the base of the greater quills is white, the rest black. It feeds on small birds, young nestlings, beetles, and caterpillars. When it has killed the prey, it fixes them on some thorn, and when thus spitted, pulls them to pieces with its bill. When confined in a cage they will often treat their food in much the same manner, sticking it against the wires before they devour it. This bird inhabits many parts of Europe and North America. The female makes its nest with heath and moss, lining it with wool and gossamer, and lays six eggs, about the size of those of a thrush, of a dull olive-green, spotted at the thickest end with black. In countries where they are plenty, the husbandmen value them, on supposition of their destroying rats, mice, and other vermin.

2. The *collurio*, or lesser butcher-bird, is seven inches and a half in length. This bird is much more common than the former species. It lays six white eggs, marked with a rufous brown circle towards the large end. The nest is generally in a hedge or low bush, near which, it is said no small bird chooses to build; for it not only feeds on insects, but also on the young of other birds in the nest, taking hold of them by the neck, and strangling them, beginning to eat them first at the brain and eyes.

3. The *infaustus*, or rock shrike, is in length seven inches and three quarters. The bill is about an inch long, and blackish; the head and neck are of a dark ash-colour, marked with small rufous spots; the upper part of the back is a dark brown; the lower much

paler, especially towards the tail; the quills and wing-coverts are dusky, with pale margins; the breast, and under parts of the body are orange, marked with small spots, some white and others brown. This species is met with in many parts of Europe, from Italy to Russia, and is found in some parts of Germany.

4. The *faustus*, or white-wreathed shrike, is about the size of a common thrush. Its bill is pale; the upper parts of the body are grey; the under ferruginous; from the eyes to the hind head there passes a whitish line, composed of numerous white feathers; rendering it truly characteristic. This elegant species inhabits China, where it is known by the name of whommaj.

5. The *tyrannus*, or tyrant shrike, is about the size of a thrush. Its bill is a blackish brown, beset with bristles at the base; the irides are brown; the upper parts of the plumage grey brown; the under white; the breast inclines to ash-colour; the head is blackish on the upper part; the base of the feathers on that part in the male is orange, but seldom visible except it erects the feathers, when there appears a streak of orange down the middle of the crown. It inhabits Virginia. There is a variety which inhabits St. Domingo and Jamaica. All authors agree in the manners of these birds, which are ferocious to a great degree; while the hen is sitting, no bird whatever dare approach their nest; they will attack the first which comes near, without reserve, and usually come off conquerors.

LANTERN, *magic*, an optical machine, whereby little painted images are represented so much magnified, as to be accounted the effect of magic by the ignorant. See OPTICS.

LANTERN. See ARCHITECTURE.

LAPIDARY. There are various machines employed in the cutting of precious stones, according to the quality. The diamond, which is extremely hard, is cut on a wheel of soft steel, turned by a mill, with diamond dust, tempered with olive-oil, which also serves to polish it. The oriental ruby, sapphire, and topaz, are cut on a copper wheel with diamond dust, tempered with olive oil, and are polished on another copper wheel with tripoli and water. The hyacinth, emerald, amethyst, garnets, agates, and other stones, not of an equal degree of hardness with the other, are cut on a leaden wheel with smalt and water, and polished on a tin wheel with tripoli.

LAPIS, in general, is used to denote a stone of any kind. See MINERALOGY.

LAPLISIA, in natural history, *sea-hare*, a genus of the vermes mollusca class and order. Body creeping, covered with reflected membranes, with a membranaceous shield on the back, covering the lungs; aperture placed on the right side; vent above the extremity of the back; four feelers, resembling ears. There are two species; viz. L. depilans; body pale lead colour; immaculate. It inhabits the European seas; from two to five inches long; is extremely nauseous and fetid, and is said to cause the hair to fall off from the hands of those who touch it. L. faciata, black; the edges of the membranaceous covering, and of the feelers scarlet; it inhabits the shores of Barbary, among rocks, and is frequently to be met with off Anglesea

LAPSED *legacy*, is where the legatee dies before the testator; or where a legacy is given upon a future contingency, and the legatee dies before the contingency happens.

LARBOARD, among seamen, the left hand side of the ship, when you stand with your face towards the head.

LARCENY, is the felonious and fraudulent taking away of the personal goods of another; which goods, if they are above the value of 12*d.* it is called grand larceny; if of that value or under, it is petit larceny; which two species are distinguished in their punishment, but not otherwise. The mind only makes the taking of another's goods to be felony, or a bare trespass only.

As all felony includes trespass, every indictment must have the words feloniously took, as well as carried away; whence it follows, that if the party be guilty of no trespass in taking the goods, he cannot be guilty of felony in carrying them away. With respect to what shall be considered a sufficient carrying away, to constitute the offence of larceny; it seems that the least removing of the thing taken, from the place where it was before, is sufficient for this purpose, though it be not quite carried off.

Larceny from the person.—If larceny from the person be done privately without his knowledge, by picking of pockets or otherwise, it is excluded from the benefit of clergy by 8 Eliz. c. 4. provided the thing stolen be above the value of 12*d.* But if done openly, and avowedly before his face, it is within the benefit of clergy.

Larceny from the house.—Every person who shall be convicted of the feloniously taking away in the day time, any money or goods of the value of 5*s.* in any dwelling-house, or outhouse thereunto belonging, and used to and with the same, though no person be therein, shall be guilty of felony, without the benefit of clergy.

Receiving stolen goods.—Any person who shall buy or receive any stolen goods, knowing them to be stolen; or shall receive, harbour, or conceal any felons or thieves, knowing them to be so; shall be deemed accessary to the felony: and being convicted on the testimony of one witness, shall suffer death as a felon convict; but he shall be entitled to his clergy.

Any person convicted of receiving or buying stolen goods, knowing them to be stolen, may be transported for fourteen years.

Every person who shall apprehend any one guilty of breaking open houses in a felonious manner, or of privately and feloniously stealing goods, wares, or merchandizes, of the value of 5*s.* in any shop, ware-house, coach-house, or stable, though it is not broken open, and though no person is therein to be put in fear, and shall prosecute him to conviction, shall have a certificate without fee, under the hand of the judge, certifying such conviction, and within what parish or place the felony was committed, and also that such felon was discovered and taken.

LARK. See ALAUDA.

LARKSPUR. See DELPHINIUM.

LARVA, in natural history, a name given by Linnæus to insects in that state, called by other writers eruca, or caterpillar.

LARUS, *the gull,* a genus in the order of anseres, the characters of which are—the bill is straight, cultrated, a little crooked at the point, and without teeth. The inferior mandible is gibbous below the apex; the nostrils are linear, a little broader before, and situated in the middle of the beak. The different species are principally distinguished by their colour. The most remarkable are,

1. The *marinus,* or black-backed gull, in length 29 inches, in breadth five feet nine. The bill is very strong and thick, and almost four inches long; the colour a pale yellow; the head, neck, whole under side, tail, and lower part of the back, are white; the upper part of the back and wings are black; the quill feathers tipt with white; the legs of a pale flesh colour. It inhabits several parts of England, and breeds on the highest cliffs. It frequents Greenland, and chiefly inhabits the distant rocks. It lays three eggs in May, placing them on the heaps of dung which the birds leave there from time to time. It is common also in America, as low as South Carolina, where it is called the old-wife.

2. The *cataractes,* or Skua gull, is in length two feet; the extent four feet and a half; the weight three pounds; the feathers on the head, neck, back, scapulars, and coverts of the wings are of a deep brown, marked with rust-colour. This bird inhabits Norway, the Ferroe isles, Shetland, and the noted rock Foula, a little west of them.

3. The *parasiticus,* or dung hunter, is in length 21 inches: the upper parts of the body, wings, and tail, are black; the base of the quills whiter on the inner webs; and the two middle feathers of the tail are near four inches longer than the rest. This is a northern species, and very common in the Hebrides, where it breeds on heath. It is also found in the Orkneys, and on the coasts of Yorkshire, where it is called the feaser.

4. The *canus,* or common gull, is in length 16 or 17 inches; in breadth 36; weight about one pound. The bill is yellow; the head, neck, under parts of the body, and tail, are white; the back and wings pale-grey. It is a tame species, and may be seen by hundreds on the shores of the Thames and other rivers, in the winter and spring, at low tides, picking up the various worms and small fish left by the tides; and will often follow the plough in the fields contiguous, for the sake of worms and insects which are turned up; particularly the cockchafer or dorbeetle in its larva state.

5. The *tridactylus,* or tarrock, is in length 14 inches, breath [illegible]; weight seven ounces. The head, neck, and under parts, are white; near each ear, and under the throat, there is a black spot: at the hind part of the neck a crescent of black; the back and scapulars are blueish-grey; the wing coverts dusky edged with grey, some of the larger wholly grey. This species breeds in Scotland, and inhabits other parts of northern Europe, quite to Iceland and Spitzbergen.

6. The *ridibundus,* peewit, or black-head gull, is in length 15 inches, breadth three feet: weight about ten ounces; the back and wings are of an ash-colour; the neck, all the under parts, and tail, are white. This species breeds on the shores of some of our rivers, but mostly in the inland fens of Lincolnshire, Cambridgeshire and other parts of England. They make their nest on the ground, with rushes, dead grass, &c. and lay three eggs of a greenish brown, marked with red-brown blotches.

LARYNX. See ANATOMY.

LAST, in general, signifies the burden or load of a ship. It signifies also a certain measure of fish, corn, wool, leather, &c. A last of codfish, white herrings, meal and ashes for soap, is 12 barrels; of corn or rapeseed, 10 quarters; of gunpowder, 24 barrels; of red-herrings, 20 cades; of hides, 12 dozen; of leather, 20 dickers; of pitch and tar, 14 barrels; of wool, 12 sacks; of stock fish, 1000; of flax or feathers, 17000 pounds.

LATH, in building, a long, thin, and narrow slip of wood, nailed to the rafters of a roof or ceiling, in order to sustain the covering. These are distinguished into three kinds, according to the different kinds of wood of which they are made, viz. heart of oak, sap-laths, and deal-laths; of which the last two are used for ceilings and partitions, and the first for tiling only. Laths are also distinguished according to their lengths; the statute allows but of two lengths, those of five and those of three feet, each of which ought to be an inch and a half in breadth, and half an inch in thickness.

LATHE, a very useful engine for the turning of wood, ivory, metals, and other materials. See TURNING.

LATHRÆA, a genus of the angiospermia order, in the didynamia class of plants, and in the natural method ranking under the 40th order, personatæ. There are four species.

LATHS, *cleaving of.* The lath-cleavers having cut their timbers into lengths, cleave each piece with wedges into 8, 12, or 16, according to the size of their timber; these pieces are called bolts; this is done by the felt-grain, which is that grain which is seen to run round in rings at the end of a piece of a tree. Thus they are cut out for the breadth of the laths, and this work is called felting. Afterwards they cleave the laths into their proper thickness with their chit, by the quarter grain, which runs in straight lines towards the pith.

LATHYRUS, *chickling vetch,* a genus of the decandria order, in the diadelphia class of plants, and in the natural method ranking under the 32d order, papilionaceæ. The species are 23.

LATITAT, in law, a writ, which in personal actions, is the commencement of a suit in the King's Bench, where the party is to be arrested in any other county than Middlesex.

LATITUDE, the distance of a place from the equator, or an arc of the meridian intercepted between the zenith of the place and the equator. Hence latitude is either northern or southern, according as the place is north or south of the equator. See GEOGRAPHY.

LATTEN denotes iron plates tinned over, of which tea-canisters are made.

LATTEN-*brass,* plates of milled brass, reduced to different thickness, according to the uses it is intended for.

LATUS *rectum,* in conic sections, the same with parameter.

LATUS *transversum,* in the hyperbola, that part of the transverse diameter, intercepted between the vertices of the two opposite sections.

LAVA, the production of Ætna, Vesuvius

Hecla, and other volcanoes, is of a greyish colour passing to green: it is spotted externally, and occurs porous, carious, or vesicular. Its lustre is vitreous, more or less glistering. It is moderately hard, brittle, easily frangible, and light. It generally attracts strongly the magnetic needle. It is easily fusible into a black compact glass.

LAVANDULA, in botany, *lavender*, a genus of the didynamia gymnospermia class and order: natural order of verticillatæ. Essential character: calyx ovate, obscurely toothed, supported by a bracte; corolla re-supine; stamina within the tube. There are seven species, of which L. spica, common lavender, has a shrubby stem much branched, frequently five or six feet high, with numerous hoary leaves, the upper ones sessile. The flowers are produced in terminating spikes from the young shoots, on long peduncles; the spikes are composed of interrupted whorls, in which the flowers are from six to ten. The usual colour of the corolla is blue, sometimes varying with white flowers. It is a native of the south of Europe, and has long been celebrated for its virtues in nervous disorders; the officinal preparations of lavender, are the essential oil, a simple spirit, and a compound tincture.

LAVATERA, a genus of the polyandria order, in the polydelphia class of plants, and in the natural method ranking under the 37th order columniferæ. There are 9 species, most of them herbaceous flowery annuals, or shrubby perennials, growing erect from two or three to eight or ten feet high.

LAUDANUM. See OPIUM.

LAUNCH, in the sea-language, signifies to put out: as, launch the ship, that is, put her out of the dock; launch aft, or forward, speaking of things that were stowed in the hold, is, put them more forward: launch ho! is a term used when a yard is hoisted high enough, and signifies hoist no more.

LAUREATION, in the universities of Scotland, signifies the act of taking the degree of master of arts, which the students are permitted to do after four years study.

LAURUS, *the bay-tree*, a genus of the monogynia order, in the enneandria class of plants, and in the natural method ranking under the 12th order, holoraceæ. There is no calyx; the corolla is calycine, or serving in place of the calyx, and sexpartite: the nectarium with three glandules, each terminated by two bristles surrounding the germen. The interior filaments furnished with glandules at the base; the fruit a monospermous plum. There are 32 species, of which the most noted are, *Laurus nobilis*, common sweet bay, grows from twenty to thirty feet in height; it has large evergreen leaves, of a firm texture with an agreeable smell, and an aromatic, bitterish taste; flowers dioecius, or male and female on different trees, in racemes shorter than the leaves, of an herbaceous colour; corollas four-petalled in the male flowers; stamens from eight to twelve; berry superior, of a dark purple colour, almost black; it is a native of the southern parts of Europe and Asia.

Laurus persea, alligator, or avocado pear of the West Indies, is about thirty feet in height; the fruit is the size of one of our biggest pears, inclosing a large seed with two lobes. It is held in great esteem in the West Indies; the pulp is of a pretty firm consistence, and has a delicate rich flavour.

Laurus-cinnamomum, or cinnamon tree, is a native of Ceylon. It has a large root, and divides into several branches, covered with a bark, which on the outer side is of a greyish brown, and on the inside has a reddish cast. The body of the tree, which grows to the height of 20 or 30 feet, is covered, as well as its numerous branches, with a bark, which at first is green and afterwards red. The leaf is longer and narrower than the common bay-tree; and it is three nerved, the nerves vanishing towards the top. The flowers are small and white, and grow in large bunches at the extremity of the branches. The fruit is shaped like an acorn, but is not so large.

LAW. The laws of England are divided into lex non scripta, or the common law; and lex scripta, or statute law. The lex non scripta is not so called from its being conveyed down from former ages by word of mouth, but because the original authority of these laws is not set down in writing, and they receive their force by long usage, and by their universal reception throughout the kingdom.

The common law is divided into two: 1st. General custom, which is the universal rule of the whole kingdom, and is the law by which proceedings and determinations in the courts of justice are ordinarily directed. This for the most part settles the course of inheritance, the manner and form of acquiring and transferring property, the solemnities and obligations of contracts, the rules of expounding wills, deeds, and acts of parliament; the remedies of civil injuries, &c.

2dly. Particular customs which concern the inhabitants of some particular district.

3dly. The third branch are those laws which are adopted by certain courts and jurisdictions as the civil and canon laws.

The civil law is understood to signify the civil law of the Roman empire. The canon law is a body of Roman ecclesiastical law relating to matters over which the church exercises a jurisdiction. The civil law is used in four courts, under certain restrictions, viz. the archbishops' and bishops' courts, usually styled curiæ christianitatis; the courts martial, the courts of admiralty, and the courts of the two universities.

The second division of the laws of England are the statutes made by the king, lords, and commons, assembled in parliament. The oldest statute extant is the celebrated Magna Charta.

Statutes are general or special, public or private: general or public acts are those which concern the whole nation; of these the judges are obliged to take notice, though they should not be formally pleaded by the party who claims an advantage under them. Special or private acts are such as operate on private persons and concerns, which must be formally set forth by the party, or the judges are not obliged to notice them.

Statutes are either declaratory of the common law, where it is become disreputable, or fallen into disuse; or remediable, when made to supply the defects, or abridge the superfluities of the common law.

There is besides those grounds of the laws of England, a court of equity to moderate and explain them. The courts of equity are, howeve

only had recourse to in matters of property; for our constitution will not permit, that in criminal cases any judge should have the power of construing the law otherwise than according to the letter.

In treating of the laws, the best mode is to divide them, 1st, Into the rights of persons, or the rights as to personal security, personal liberty, and private property. 2nd, The rights of things, or the rights which a man may acquire in, and to such external things as are unconnected with his person. 3d, Private wrongs, or such as are the infringement of the private rights of individuals; and 4th, Public wrongs, or such as are a violation of the public rights, and affect the whole community.

LAW *of nations*, is a system of rules deducible by natural reason, from the immutable principles of natural justice, and established by universal consent among the civilized inhabitants of the world, in order to decide all disputes, and to insure the observance of justice and good faith, in that intercourse which must frequently occur between them and the individuals belonging to each; or they may depend upon mutual compacts, treaties, leagues, and agreements between the separate, free, and independent communities. In the construction of these principles, there is no judge to resort to, but the general law of nature and of reason, being the only law with which the contracting parties are all equally conversant, and to which they are all equally amenable.

LAWSONIA, *Egyptian privet*, a genus of the monogynia order, in the octandria class of plants, and in the natural method ranking with those of which the order is doubtful. The calyx is quadrifid; the petals four; the stamina four, in pairs; the capsule is quadrilocular and polyspermous. There are four species, all natives of India.

LAXMANNIA, in botany, a genus of the hexandria monogynia class and order. Essential character: calyx one-leafed, four-toothed, inferior; corolla four petalled; berry four-celled; seeds solitary.

LAY-BROTHERS, among the Romanists, those pious but illiterate persons, who devote themselves, in some convent to the service of the religious.

LAY-MAN, among painters, a small statue whose joints are so formed, that it may be put into any attitude for the purpose of adjusting the drapery of figures.

LAYERS, are tender shoots, or twigs of trees, laid in the ground; till having struck root they are separated from the parent tree, and become distinct plants.

LAZULITE. This mineral is often found in oblique quadrangular crystals of a fine blue colour. It is translucent only on the edges, brittle, and nearly as hard as quartz. When massive, it is either in grains, or in pieces of the size of a hazel nut. It occurs imbedded in mica slate. Its lustre is vitreous. Its constituents are 66 alumina, 18 magnesia, 10 silica, 2.5 oxide of iron, 2 lime. It occurs in Vorau in Stiria, in a gangue of quartz: but the finest specimens of it come from the bishopric of Salzburg.

LEAD is a white metal of a considerably blue tinge, very soft and flexible, not very tenacious, and consequently incapable of being drawn into fire, though it is easily extended into thin plates under the hammer. Its sp. gr. is 11.35. It melts at 612°. In a strong heat it boils, and emits fumes; during which time, if exposed to the air, its oxidation proceeds with considerable rapidity. Lead is brittle at the time of congelation. In this state it may be broken to pieces with a hammer, and the crystallization of its internal parts will exhibit an arrangement in parallel lines. Lead is not much altered by exposure to air or water, though the brightness of its surface, when cut or scraped, very soon goes off. It is probable that a thin stratum of oxide is formed on the surface, which defends the rest of the metal from corrosion.

There are certainly two, perhaps three oxides of lead:—1. The powder precipitated by potash from the solution of the nitrate of lead, being dried, forms the yellow protoxide. When somewhat vitrified, it constitutes litharge, and combined with carbonic acid, white-lead or ceruse.

2. When massicot has been exposed for about 48 hours to the flame of a reverberatory furnace, it becomes red-lead, or minium. This substance has a sp. gr. of 8.94. At a red heat it gives out oxygen, and passes into vitrified protoxide. It consists of 100 lead + 11.08 oxygen; and it may be represented as a compound of 2 primes of lead + 3 oxygen; or of 1 prime protoxide + 1 prime peroxide.

3. If upon 100 parts of red-lead we digest nitric acid of the sp. gr. 1.26, 92.5 parts will be dissolved, but 7.5 of a dark brown powder will remain insoluble. This is the peroxide of lead.

By passing a stream of chlorine through red-lead diffused in water, we obtain a solution, which yields by potash an abundant precipitate of the brown oxide of lead.

Most of the acids attack lead. The sulphuric does not act upon it, unless it be concentrated and boiling. Sulphurous acid gas escapes during this process, and the acid is decomposed. When the distillation is carried on to dryness, a saline white mass remains, a small portion of which is soluble in water, and is the sulphate of lead; it affords crystals. Nitric acid acts strongly on lead.

Muriatic acid acts directly on lead by heat, oxidizing it, and dissolving part of its oxide.

The acetic acid dissolves lead and its oxides; though probably the access of air may be necessary to the solution of the metal itself in this acid. *White-lead* or *ceruse*, is made by rolling leaden plates spirally up, so as to leave the space of about an inch between each coil and placing them vertically in earthern pots, at the bottom of which is some good vinegar. The pots are to be covered, and exposed for a length of time to a gentle heat in a sand bath, or by bedding them in dung. Ceruse is the only white used in oil paintings. Commonly it is adulterated with a mixture of chalk in the shops. This, like all the preparations of lead, is a deadly poison. The common sugar of lead is an acetate; and Goulard's extract, made by boiling litharge in vinegar, a subacetate. The power of this salt, as a coagulator of mucus, is superior to the other. If a bit of zinc be suspended by brass or iron wire, or a thread, in a mixture of water and the acetate of lead, the lead will be revived, and form an arbor Saturni.

The acetate, or sugar of lead, is usually crystallized in needles, which have a silky appearance. They are flat four-sided prisms with dihedral summits, Its sp. gr. is 2.345. It is soluble in three and a half times its weight of cold water, and in somewhat less of boiling water.

When lead is alloyed with an equal weight of tin, or perhaps even less, it ceases to be acted on by vinegar. Actetate and subacetate of lead in solution, have been used as external applications to inflamed surfaces, and scrofulous sores, and as eye-washes. The colic of the painters, and that formerly prevalent in certain counties of England, from the lead used in the cyder presses, shew the very deleterious operation of the oxide, or salts of this metal, when habitually introduced into the system in the minutest quantities at a time.

Dealers in wines have occasionally sweetened them, when acescent, with litharge or its salts. This deleterious adulteration may be detected by sulphuretted hydrogen water, which will throw down the lead in a state of a dark brown sulphuret. Or, subcarbonate of ammonia, which is a very delicate test, may be employed to precipitate the lead in the state of a white carbonate; which, on being washed and digested with sulphuretted hydrogen water, will instantly become black. Chromate of potash will throw down from saturnine solutions a beautiful orange-yellow powder. Burgundy wine, and all such as contain tartar, will not hold lead in solution, in consequence of the insolubility of the tartrate.

Lead unites with most of the metals. Gold and silver are dissolved by it in a slight red heat. Both these metals are said to be rendered brittle by a small admixture of lead, though lead itself is rendered more ductile by a small quantity of them.

Iron does not unite with lead, as long as both substances retain their metallic form. Tin unites very easily with this metal, and forms a compound, which is much more fusible than lead by itself, and is, for this reason, used as a solder for lead. Two parts of lead and one of tin, form an alloy more fusible than either metal alone: this is the solder of the plumbers. Bismuth combines readily with lead, and affords a metal of a fine close grain, but very brittle. A mixture of eight parts bismuth, five lead, and three tin, will melt in a heat below that of boiling water. Antimony forms a brittle alloy with lead. Nickel, cobalt, manganese, and zinc, do not unite with lead by fusion. All the oxides of lead are easily revived with heat and carbon.

LEAF. See Botany.

Leaf-*gold.* See Gold, Gilding, &c.

Leaf. See Architecture.

LEAGUE, a measure of length, containing more or less geometrical paces, according to the different usages and customs of countries. A league at sea, where it is chiefly used by us, contains three thousand geometrical paces, or three English miles. The French league sometimes contains the same measure, and in some parts of France it consists of three thousand five hundred paces: the mean or common league consists of two thousand four hundred paces, and the little league of two thousand. Seventeen Spanish leagues make a degree, or sixty-nine and a half English statute miles. The Dutch and German leagues contain each four geographical miles. The Persian leagues are nearly of the same extent with the Spanish; that is, they are equal to four Italian miles, which is pretty near to what Herodotus calls the length of the Persian parasang, which contained thirty stadia, eight of which make a mile.

LEAK, among seamen, is a hole in the ship through which the water comes in. To spring a leak is said of a ship that begins to leak; to stop a leak, is to fill it with a plug wrapt in oakum and well tarred; or putting in a tarpaulin clout, to keep the water out; or nailing a piece of sheet lead upon the place.

LEAKAGE, the state of a vessel that leaks, or lets water, or other liquid, ooze in or out. Leakage, in commerce, is an allowance of 12 per cent. in the customs, allowed to importers of wines, for the waste and damage it is supposed to have received in the passage; an allowance of two barrels in twenty-two is also made to the brewers of ale and beer, by the excise office.

LEAP, in music. This word is properly applicable to any disjunct degree, but is generally used to signify a distance consisting of several intermediate intervals.

Leap-*year.* See Bissextile.

LEASE, a conveyance of lands, generally in consideration of rent or other annual recompence made for life, for years, or at will, but always for a shorter term than the lessor has in the premises, otherwise it partakes more of the nature of an assignment.

All leases of lands, except leases not exceeding three years, must be made in writing, and signed by the parties themselves, or their agents duly authorised, otherwise they will operate only as leases at will. If a lease is but for half a year, or a quarter, or less time, the lessee is respected as a tenant for years. To constitute a good lease, there must be a lessor not restrained from making the lease to the extent for which it is granted; a lessee capable of receiving it; and the interest demised must be a demisable interest, and be sufficiently and properly described. If it is for years, it must have a certain commencement and determination; it is to have all the usual ceremonies as sealing, delivery, &c.; and there must be an acceptance of the thing demised.

The following points may be necessary to be specified here concerning leases. First, they must have a certain commencement and end. Leases for life must not be made to commence at a future day, and there must be a livery of seisin. They must now be stamped as a lease, to be valid; and any form of writing will constitute a lease, provided it contains words of present demise, or actual letting; but if it be only an agreement to let, it conveys no immediate title in law, but only an equitable right to have a lease, or to sue at law for not making one. If a lease is made to one for years, and at the same time to another for a longer time, the last lease is not void, but shall take effect after the first expires. A tenant for life can, in general, only grant a lease to endure during his life, but sometimes a power is annexed to such an estate, to grant leases for a specified time, and under particular limitations, all which must be strictly complied with, or the lease is void; and instances have happened, where building-leases have been set aside, and persons ruined by having granted under-leases. An infant may make a lease; but may set it aside when he comes of age; and the Court of Chan-

cery is empowered to grant leases for idiots, lunatics, infants, and married women.

The rent must be reserved to the executor or the heir of the lessor, according as his estate is real or personal. Lessees are bound to repair, unless the contrary is specified; and although if the house is burnt by accident they are not bound to rebuild, yet they must if the fire be by negligence; and if there is a covenant to pay rent, and a covenant to repair, except in case of fire, yet rent is payable, although the house is not rebuilt by the landlord. If there is a covenant not to assign, lease, or under-let, without licence of the landlord, the tenant cannot even grant an under-lease.

Upon a lease at will, six months' notice to quit must generally be given by either party, to determine on the same day in the year when the lease commenced. Leases made by spiritual persons of their church-lands, must be strictly conformable to certain statutes called the enabling and disabling statutes. The tenant may, at the trial of an ejectment, insist upon his notice to quit being insufficient, although he made no objection when it was served.

LEASES, *value of.* The purchaser of a lease may be considered as the purchaser of an annuity equal to the rack-rent of the estate; and the same principles from which are deduced the present value of annuities to continue during any given term, will apply to the value of leases. The sum paid down for the grant of a lease is so much money paid in advance for the annual rents as they may become due; or, it may be considered as a sum which put out to interest, will enable the lessor to repay himself the rack-rent of the estate, or the yearly value of his interest therein, during the given term. In order to find what this sum should be, it would be necessary to ascertain separately the present value of each annual rent, or the sum which, put out to interest at the given rate, will enable the landlord to repay himself the several yearly rents as they become due. The following Table shews the number of years' purchase that ought to be given for a lease, for any number of years not exceeding 100, at 6, 7, and 8 per cent. interest.

	6 per Cent.	7 per Cent.	8 per Cent.
1	.9433	.9345	.9259
2	1.8333	1.8080	1.7832
3	2.6730	2.6243	2.5770
4	3.4651	3.3872	3.3121
5	4.2123	4.1001	3.9927
6	4.9173	4.7665	4.6228
7	5.5823	5.3892	5.2063
8	6.2097	5.9712	5.7466
9	6.8016	6.5152	6.2468
10	7.3600	7.0235	6.7100
11	7.8868	7.4986	7.1389
12	8.3838	7.9426	7.5360
13	8.8526	8.3576	7.9037
14	9.2949	8.7454	8.2442
15	9.7122	9.1079	8.5594
16	10.1058	9.4466	8.8513
17	10.4772	9.7632	9.1216
18	10.8276	10.0590	9.3718
19	11.1581	10.3355	9.6035
20	11.4699	10.5940	9.8181
21	14.7640	10.8355	10.0168
22	12.0415	11.0612	10.2007
23	12.3033	11.2721	10.3710
24	12.5503	11.4693	10.5287
25	12.7833	11.6535	10.6747
26	13.0031	11.8257	10.8099
27	13.2105	12.9867	10.9351
28	13.4061	12.1371	11.0510
29	13.5907	12.2776	11.1584
30	13.7648	12.4090	11.2577
31	13.9290	12.5318	11.3497
32	14.0840	12.6465	11.4349
33	14.2302	12.7537	11.5138
34	14.3681	12.8540	11.5869
35	14.4982	12.9476	11.6545
36	14.6209	13.0352	11.7171
37	14.7367	13.1170	11.7751
38	14.8460	13.1934	11.8288
39	14.9490	13.2649	11.8785
40	15.0462	13.3317	11.9246
41	15.1380	13.3941	11.9672
42	15.2245	13.4524	12.0066
43	15.3061	13.5062	12.0432
44	15.3831	13.5579	12.0770
45	15.4558	13.6365	12.1084
46	15.5243	13.6500	12.1374
47	15.5890	13.6916	12.1642
48	15.6500	13.7304	12.1891
49	15.7075	13.7667	12.2121
50	15.7618	13.8007	12.2334
51	15.8130	13.8324	12.2532
52	15.8613	13.8621	12.2715
53	15.9069	13.8898	12.2884
54	15.9499	13.9157	12.3041
55	15.9905	13.9399	12.3186
56	16.0288	13.9625	12.3320
57	16.0649	13.9837	12.3444
58	16.0989	14.0034	12.3560
59	16.1311	14.0219	12.3669
60	16.1614	14.0391	12.3765
61	16.1900	14.0553	12.3856
62	16.2170	14.0703	12.3941
63	16.2424	14.0844	12.4020
64	16.2664	14.0976	12.4092
65	16.2891	14.1099	12.4159
66	16.3104	14.1214	12.4222
67	16.3306	14.1321	12.4279
68	16.3496	14.1422	12.4333
69	16.3676	14.1516	12.4382
70	16.3845	14.1603	12.4428
71	16.4005	14.1685	12.4470
72	16.4155	14.1762	12.4509
73	16.4297	14.1834	12.4546
74	16.4431	14.1901	12.4579
75	16.4558	14.1963	12.4610
76	16.4677	14.2022	12.4639
77	16.4790	14.2076	12.4666
78	16.4896	14.2127	12.4691
79	16.4996	14.2175	12.4713
[illegible]	16.5091	14.2220	12.4735
81	16.5180	14.2261	12.4754
82	16.5264	14.2300	12.4772
83	16.5343	14.2337	12.4789
84	16.5416	14.2371	12.4805
85	16.5489	14.2403	12.4819
86	16.5556	14.2432	12.4833
87	16.5618	14.2460	12.4845
88	16.5678	14.2486	12.4856
89	16.5734	14.2510	12.4867
90	16.5787	14.2533	12.4877
91	16.5836	14.2554	12.4886
92	16.5883	14.2574	12.4894
93	16.5928	14.2592	12.4902
94	16.5969	14.2610	12.4909
95	16.6209	14.2626	12.4916
96	16.6046	14.6046	12.4922
97	16.6081	14.2655	12.4928
98	16.6114	14.2668	12.4933
99	16.6145	14.2680	12.4938
100	1.66175	14.2692	12.4943

In order to find the value of a lease, it is first necessary to ascertain the true rack-rent of the estate, or the annual value that it may be justly estimated to be worth. On this point difficulties will sometimes arise; for the value of an estate depending very often on some real or supposed advantages, or on some local or personal recommendations, will in many instances, occasion a difference of opinion. However, when all these circumstances have been taken into consideration, some annual rent equivalent thereto must be assumed, and when this is settled the value of the lease will be easily found. Thus, if an estate is worth 150*l.* yearly rent, the value of a lease thereof for sixty-nine years, allowing the purchaser 6 per cent. interest for his money, is 16,3676 (the number in the table) multiplied by 150, or 2455*l.* 2*s.* 9*d.* In many instances, the rent of the estate intended to be leased is charged with some annual expence, such as a reserved or quit rent, the payment of an annuity, taxes, and the like; in such cases the number of years' purchase found in the table ought to be multiplied by the difference only between such annual expence and the whole estimated rent of the estate.

In order to find the annual rent corresponding to any given sum paid for a lease, divide the sum paid by the number of years' purchase that are found against the given term in the table, and the quotient will be the annual rent required. Example:—A person has given 1000*l.* for the lease of an estate for 16 years, what annual rent is equivalent thereto, in order to allow the purchaser 7 per cent. interest for his money. In the table against 16 years, and under 7 per cent. we shall find the number of years' purchase to be 9,4466; therefore 1000 divided by 9,4466 gives 105*l.* 17*s.* for the annual rent required.

It frequently happens that a long lease is not to be entered on or enjoyed till after the expiration of a short lease, or till the end of a given number of years; in such cases, deduct the value of the short lease, or the value set against the given number of years in the table, from the value of the longer lease, and the difference will give the true present value of the longer lease.

LEASE and RELEASE, a conveyance of the fee simple, right, or interest, in lands or tenements, under the statute of uses, 27 Henry VIII. c. 10, giving first the possession, and afterwards the interest, which in law is equivalent to a feoffment. It was invented to supply the place of livery of seisin, and is thus contrived: a lease, or rather bargain and sale, upon some pecuniary consideration, for one year, is made by the tenant of the freehold to the lessee or purchaser, which vests in him the use of the term for a year; and then the statute of uses, 27 Henry VIII. c. 10, immediately transfers the use into possession.

LEATHER. See TANNING.

LEAVEN. See FERMENTATION.

LECHŒA, a genus of the triandria trigynia class and order. There are three species, herbaceous plants of America and China.

LEDGER, the principal book wherein merchants enter their accounts. See BOOK-KEEPING.

LEDGES in a ship, are small pieces of timber lying athwart from the waste-trees to the roof-trees: they serve to bear up the gratings or nettings over the half-deck.

LEDUM, marsh cistus, or wild rosemary; a genus of the monogynia order, in the decandria class of plants; and in the natural method ranking under the 18th order, bicornes.

There are three species:—the palustre with very narrow leaves, grows naturally upon bogs and mosses in many parts of Yorkshire, Cheshire, and Lancashire.

LEE, in the sea language, a word of various significations, though it is generally understood to mean the part opposite to the wind. Thus lee-shore, is that shore against which the wind blows. Lee-latch, or have a care of the lee-latch, is, take care that the ship do not go to the leeward, or too near the shore; a lee the helm, put it to the leeward side of the ship; to lie by the lee, or to come up to the lee, is to bring the ship so, that all her sails may lie flat against her masts and shrouds, and that the wind may come right upon her broadside.

LEE-WAY, is the angle that the rhumb-line upon which the ship endeavours to sail, makes with the rhumb upon which she really sails.

LEEA, a genus of the class and order pentandria monogynia. The calyx is one-petalled; nect. on the side of the corolla, upright, five-cleft; berry, five-seeded, There are three species, trees of the East Indies.

LEECH. See HIRUDO.

LEEK. See ALLIUM.

LEERSIA, a genus of the class and order triandria digynia. Calyx none; glume, two-valved, closed. There are three species, grasses of America.

LEET, a little court held within a manor, and called the king's court; because its authority to punish offences originally belonged to the crown.

LEETCH-*lines*, small ropes made fast to the leetch of the top-sails, to which they belong, and reeved into a block at the yard close by the top-sail-ties.

LEGACY, a bequest of a sum of money, or any personal effects of a testator; and these are to be paid by his representatives, after all the debts of the deceased are discharged, as far as the assets will extend.

All the goods and chattels of the deceased are by law invested in the representative, who is bound to see whether there be left a sufficient fund to pay the debts of the testator, and if it should prove inadequate, the pecuniary legacies must proportionally abate; a specific legacy, however, is not to abate unless there be insufficient without it. If the legatee die before the testator, such will in general be termed a lapsed legacy, and fall into the general fund; where, however, from the general import of the will, it can be collected that the testator intended such a vested legacy, it will in such case go to the representative of the deceased legatee. If a bequest be made to a person, if or when he attains a certain age, the legacy will be lapsed, if he die before he attain that age. But if such legacy may be made payable at that age, and the legatee die before that age, such legacy will be vested in his representative. If in the latter case, the testator devise interest to be paid in the mean time, it will nevertheless be a vested legacy.

Where a legacy is bequeathed over to an-

other, in case the first legatee die under a certain age, or the like, the legacy will be payable immediately on the death of the first legatee; and though such legacy be not bequeathed over, yet if it carry interest, the representative will become immediately entitled to it.

In case of a vested legacy due immediately, and charged on land, or money in the funds which yields an immediate profit, interest shall be payable from the death of the testator; but if it be charged on the personal estate only of the testator, which cannot be collected in, it will carry interest only from the end of the year after the death of the testator.

If a bequest be for necessaries, and of small amount, the executor will be justified in advancing a part of the principal; but this should be done under very particular circumspection, as the executor may be compelled to pay the full legacy on the infant's attaining his majority, without deducting the sum previously advanced.

When all the debts and particular legacies are discharged, the residue or surplus must be paid to the residuary legatee, if any be so appointed in the will; but if there be none appointed or intended, it will go to the executor or next of kin. When this residue does not go to the executor, it is to be distributed among the intestates next of kin, according to the statute of distributions; except the same is otherwise disposable by particular customs, as those of London, York, &c. See Executor.

LEGATE, a cardinal or bishop, whom the Pope sends as his ambassador to sovereign princes.

LEGERDEMAIN, a term applied to certain deceptive performances, which depend either on dexterity and address, or derive but a small degree of aid from philosophical principles.

The grand requisite in the exercise of this art is, to take off the attention, as much as possible, from the fingers of the performer; and this is generally effected by the volubility of tongue which he displays during the performance of his tricks. Immense labour is necessary to acquire superiority in this art. One of the most eminent performers that ever appeared in this country assured the editor, that for twenty years he had practised in private in the most laborious manner, and that he found it necessary to continue this regularly. In contemplating this subject, it is impossible to avoid being struck with the similarity between it and the amazing execution of the skilful musician. Both the juggler and the musician can carry on, with undeviating correctness, the operations of their fingers, while they are engaged in talking on subjects of a very opposite nature.

Dugald Stewart, in his elements of the philosophy of the human mind, has a remark which, as it certainly accounts on just grounds for the dexterity acquired by the professors of legerdemain, we shall here give in his own words.

"The dexterity of jugglers (which, by the way, merits a greater degree of attention from philosophers than it has yet attracted) affords many curious illustrations of the same doctrine —alluding to the possibility of our exerting acts of the *will*, which we are unable to recollect. "The whole of this art seems to me to be founded on this principle: that it is possible for a person, by long practice, to acquire a power, not only of carrying on certain intellectual processes more quickly than other men, (for all the feats of legerdemain suppose the exercise of observation, thought, and volition,) but of performing a variety of movements with the hand, before the eyes of a company, in an interval of time too short to enable the spectators to exert that degree of attention which is necessary to lay a foundation for memory."

LEGION, in Roman antiquity, a body of foot which consisted of different numbers at different periods of time. The word comes from *legere*, to choose, because when the legions were raised the Romans made choice of such of their youth as were most proper to bear arms. Romulus fixed the number of the legion at 3000; but, according to Plutarch, he afterwards increased it to 6000.

LEGUMEN, in botany, that species of seed vessel termed a pod, in which the seeds are fastened along one suture only. In this the seed-vessel in question differs from the other kind of pod, termed by botanists siliqua, in which the enclosed seeds are fastened alternately to both the sutures or joinings of the valves. The seed-vessels of all the pea-bloom or butterfly-shaped flowers, the Diadelphia of Linnæus, is of the leguminous kind; such is the seed-vessel of the pea, vetch, lupine, &c.

LEMMA, in mathematics, a proposition which serves previously to prepare the way for the more easy apprehension of the demonstration of some theorem, or construction of some problem.

LEMNA, a genus of the monœcia diandria class and order. The male cal. is one-leaved; cor. none; female, cal. one-leaved; cor. none; style one; caps. one-celled. There are six species, known by the name of duck-weed, or duck-meat.

LEMNISEA, a genus of the class and order polyandria monogynia. The cal. is five-toothed; cor. six-petalled, recurved; nect. cap-shaped, girding; the germ. per. five-celled, seeds solitary. There is one species, a tree of Guiana.

LEMON. See Citrus.

Lemon, *salt of*. See Oxalate of potass.

LEMUR, *macauco*, a genus of quadrupeds of the order primates: the generic character is, front-teeth in the upper jaw, four; the intermediate ones remote: in the lawer jaw, six; longer, stretched forwards, compressed, parallel, approximated; canine teeth solitary, approximated; grinders several, sublobated; the foremost somewhat longer and sharper.

The genus lemur consists of animals approaching to monkeys in the form of their feet, which, in most species, are furnished with flat nails; but differing in their manners, and void of that mischievous and petulent disposition which so much distinguishes the monkey tribe from other quadrupeds.

There are thirteen species, of which the following are the most remarkable —

L. *tardigradus*, or the loris. This is of a light brown colour, and of the usual size of a cat. It walks and climbs with great slowness and is supposed incapable of leaping. Its manners are gentle and interesting, it is extremely susceptible of cold, and when exposed to a

strong degree of it, is agitated with extreme uneasiness. It sleeps from sun-rise to sun-set without intermission, rolled up in the manner of the hedge-hog: it is extremly attentive to cleanliness, licking its full and rich fur with the same assiduity as a cat. Its food consists of plantains, mangoes, and other fruits, and it is remarkably fond of grasshoppers.

L. indri, is a native of Madagascar, is the largest of the genus, has a face of a dog-like form, and a fur thick and soft. It has no appearance of a tail: it is very docile, and sometimes trained by the natives to hunt various animals. It is about three feet and a half in height.

L. macauco, or the ruffed macauco, is found in some of the Indian islands, and is particularly numerous at Madagascar. It is full of energy and fierceness, and its voice is so strong as to fill the woods with its sound.

L. catta, or the ring-tailed macauco. In their state of nature these animals are seen in companies of twenty or thirty. They feed on almost every species of fruits, and, in a state of confinement, like several others of this genus, will take animal food without any hesitation. They are the most elegant and beautiful species of the whole genus, are lively and gentle, and so agile and elegant in their movements, as to be highly interesting. This animal inhabits Madagascar, is of the size of a small cat, which it resembles in purring.

LENS, in dioptrics, properly signifies a small roundish glass, of the figure of a lentil; but is extended to any optic glass, not very thick, which either collects the rays of light into a point, in their passage through it, or disperses them further apart, according to the laws of refraction. See OPTICS.

LEO, in astronomy, one of the twelve signs of the zodiac, the fifth in order; containing, according to Ptolemy, thirt-ytwo stars; according to Tycho, thirty-seven; and in the Britannic catalogue, there are no less than ninety-four. The star called the lion's heart, cor-leonis, regulus, and basilicus, is a fixed star of the first magnitude.

LEONTICE, *lion's leaf*, is a genus of the monogynia order, in the hexandria class of plants: and in the natural method ranking under the 24th order, corydales. There are three species, natives of the southern parts of Europe, two of which are sometimes cultivated in this country. These are, 1. The chrysogonum with winged leaves: and 2. The leontopetalum with decompounded leaves. But those plants are natives of the Archipelago islands, and also grow in the corn-fields about Aleppo in Syria, where they flower soon after Christmas.

LEONTODON, *dandelion*, a genus of the polygamia æqualis order, in the syngenesia class of plants; and in the natural method ranking under the 49th order, compositæ. The receptacle is naked; the calyx imbricated, with the scales somewhat loose; the pappus feathery. There are four species, of which the only remarkable one is the taraxacum, or common dandelion, found on the road sides, in pastures, and on the banks of ditches.

LEOPARD. See FELIS.

LEOPARD'S *bane*. See DORONICUM.

LEPAS, a genus of vermes testacea: the animal a triton, shell affixed at the base, and consisting of many unequal erect valves. The lepas antifera, or duck-barnacle, has the shell compressed, five-valved, smooth, seated on a peduncle. It inhabits most seas, and is found fixed in clusters to the bottom of vessels, and old pieces of floating timber, generally whitish with a blue cast, the margin of the valves yellow; sometimes marked with black; peduncle long, coriaceous, black, and much wrinkled towards the shell, and growing pale and pellucid towards the base.

LEPIDIUM, DITTANDER, or *pepper-wort*: a genus of the siliculosæ order, in the tetradynamia class of plants; and in the natural method ranking under the 39th order, siliquosæ. There are 23 species, of which the only remarkable one is the latifolium or common ditander. This is a native of many parts of England.

LEPIDOPTERA, in zoology, an order of insects with four wings, which are covered with imbricated squamulæ: add to this that the mouth is commonly spiral.

Under this order are comprehended the phalæna, sphinx, and papilo genera.

LEPISMA, a genus of insects of the order aptera; lip membranceous, rounded, emarginate; four feelers, of which two are setaceous, and two capitate; antennæ setaceous; body imbricate, with scales; tail ending in setaceous bristles; six legs, formed for running. There are seven species; of these the principal is L. saccharina; scaly, silvery, lead-colour, with a triple tail. It inhabits America, among sugar, but is naturalized in Europe, and found among old books and furniture; it runs exceedingly swift, and is caught with difficulty.

LEPROSY, a foul cutaneous disease, appearing in dry, white, thin, scurfy scabs, either on the whole body, or only some part of it, and usually attended with a violent itching, and other pains. Leprosy is of various kinds; but that to which the Jews were so subject, was the elephantiasis.

LEPUS, *hare*, a genus of quadrupeds of the order glires. The generic character is, front-teeth two both above and below, the upper pair duplicate; two small interior ones standing behind the exterior. This genus exhibits particularities of structure, deviating somewhat from that of the glires, and making an indistinct approach to the pecora or ruminants.

The most remarkable species are:—1. *Lepus timidus*, common hare. The hare is an animal so familiarly known as to supersede the necessity of minute description. It is a native not only of every part of Europe, but of almost every part of the old continent. It may perhaps be doubted whether it is an aboriginal native of any part of America.

The favourite residence of the hare is in rich, dry, and flat grounds: it is rarely discovered in very hilly or mountainous situations. It feeds principally by night, and remains concealed during the day in its form, beneath some bush, or slight shelter. The swiftness of this animal is proverbial, and on account of the conformation of its fore-legs, it is observed to run to most advantage on slightly ascending ground. The hare is a very prolific animal, generally producing three or four young at a time, and breeding several times in a year The hare is an animal proverbially timid, and flies, if disturbed, by the slightest alarm. A most sin-

gular variety of this animal is sometimes found, which is furnished with rough and slightly branched horns, bearing a considerable resemblance to those of a roe-buck.

2. *Lepus variabilis,* varying hare. This species is an inhabitant of the loftiest alpine tracts in the northern regions of the globe; occurring in Norway, Lapland, Russia, Siberia, and Kamtschatka; and in our own island on the mountains of Scotland. In its general appearance it bears an extreme resemblance to the common hare, but is of smaller size, and has shorter ears and more slender legs. Its colour in summer is a tawny grey; in winter entirely white, except the tips of the ears, which are black. This animal is observed to confine itself altogether to elevated situations, and never to descend into the plains, or to mix with the common hare. The change of colour commences in the month of September, and the grey or summer coat re-appears in April; but in the very severe climate of Siberia, it continues white all the year round.

3. *Lepus Americanus,* American hare. This animal is not much superior in size to a rabbit, measuring about eight inches. Its colour nearly resembles that of the common hare, to which it seems much allied; but the fore legs are shorter, and the hind ones longer in proportion. The belly is white; the tail black above and white beneath. The ears tipped with grey, and the legs of a pale-ferruginous colour.

4. *Lepus cuniculus,* rabbit. The rabbit bears a very strong general resemblance to the hare, but is considerably smaller, and its fore feet are furnished with sharper and longer claws in proportion. Thus enabling it to burrow in the ground, and to form convenient retreats. Its colour, in the wild state, is a dusky brown, paler or whitish on the under parts, and the tail is black above and white below. In a domestic state the animal varies into black, black and white, silver grey, perfectly white, &c. The rabbit is a native of most of the temperate and warmer parts of the old continent, but is not found in the northern regions, and is not originally a native of Britain, but was introduced from other countries. Its general residence is in dry, chalky, or gravelly soils, in which it can conveniently burrow. It is so prolific an animal that it has been known to breed seven times in a year, and to produce not less than eight young each time.

Besides the above there are the Lepus Viscaccia; the Alpinus; the Octogono; and the Pusillus.

LESKIA, a genus of the class and order cryptogamia musci; a moss of little note.

LESSOR and **LESSEE,** in law. See LEASE.

LETHARGY, in medicine, a disease wherein such a profound drowsiness or sleepiness attends the patient, that he can scarce be awaked, and if awaked, he remains stupid, without sense or memory, and presently sinks again into his former sleep.

LETTER, a character used to express one of the simple sounds of the voice; and as the different simple sounds are expressed by different letters, these, by being differently compounded, become the visible signs or characters of all the modulations and mixtures of sounds used to express our ideas in a regular language.

Letters are distinguished into vowels, consonants, mutes, liquids, diphthongs, and characteristics. They are also divided into labial, dental, guttural, and palatal, and into capital and small letters. They are also denominated from the shape and turn of the letters: and in writing are distinguished into different hands, as round-text, german-text, round-hand, Italian, &c. and in printing into roman, italic, and black letter. See ALPHABET WRITING, and FOUNT.

LETTER. A servant of the post-office is within the penalty of 5 Geo. III. c. 25, which makes it a capital felony to secrete a letter containing any bank note, though he has not taken the oath required by 9 Anne, c. 10.

LETTER *of credit,* is where a merchant or correspondent writes a letter to another, requesting him to credit the bearer with a certain sum of money.

LETTER *of licence,* is a written permission granted to a person under embarrassment, allowing him to conduct his affairs for a certain time without being molested.

LETTER *of attorney,* is an instrument giving to a second person the authority to do any lawful act in the stead of the maker. They are sometimes revokable and sometimes not: in the latter case the word irrevocable is inserted. The authority must be strictly pursued; and if the attorney does less than the power it shall be void; if more, it shall be good as far as the power goes, and void as to the rest.

LETTERS, *threatening.* To send letters threatening to accuse a person of any crime punishable with death or any infamous punishment, and knowingly to send any anonymous or fictitious letter threatening to kill any one, or set fire to their tenements or property, with a view of extorting money or valuables from them, is in the first instant punishable with fine, imprisonment, pillory, whipping, or transportation for seven years, and in the other instance is felony without benefit of clergy.

LETTERS *patent.* See PATENTS.

LETTERS, *close,* are grants of the king specially distinguished from letters patent, in that the letters close, being not of public concern, but directed to particular persons, are closed up and sealed.

LETTERS *of marque,* are extraordinary commissions, granted to captains or merchants for reprisals, in order to make a reparation for those damages they have sustained, or the goods they have been deprived of by strangers at sea

These appear always joined to those of reprise, for the reparation of a private injury: but under a declared war the former only are required.

LEVARI *facias,* is a writ directed to the sheriff for levying a certain some of money upon the lands, &c. of a person who has forfeited his recognizance.

LEUCITE. This stone is usually found in volcanic productions. It is always crystallized. The primitive form of its crystals is either a cube or a rhomboidal dodecanhedron, and its integrant molecules are tetrahedons; but the varieties hitherto observed are all polyhedrons. Its texture is foliated; its fracture somewhat conchoidal: specific gravity from 2.455 to 2.490: colour white, or greyish white. It is

composed of 54 parts silica, 23 alumina, 32 potass.

LEVEL, an instrument used to make a line parallel to the horizon, and to continue it out at pleasure; and by this means to find the true level, or the difference of ascent or descent, between two or more places, for conveying water, draining fens, &c. See NAVIGATION, INLAND, and SURVEYING.

LEVELLING. See as above.

LEVER. See MECHANICS.

LEVIGATION. The mechanical process of grinding the parts of bodies to a fine paste, by rubbing the flat face of a stone called the muller, upon a table or slab called a stone. Some fluid is always added in this process. The advantage of levigation with a stone and muller, beyond that of triturating in a mortar, is, that the materials can more easily be scraped together, and subjected to the action of the muller, than in the other case to that of the pestle; and, from the flatness of the two surfaces, they cannot elude the pressure.

LEY, or *lees*, a term usually applied to any alkaline solution made by levigating any ashes that contain an alkali. Soap lees is an alkali used by soap-boilers, or potash or soda in solution, and made caustic by lime. Lees of wine are the refuse, or sediment, that deposits from wine by standing quiet.

LEYDEN *phial.* See ELECTRICITY.

LEYSERA, a genus of the polygamia superflua order, in the syngenesia class of plants, and in the natural method ranking under the 49th order, compositæ.

LIBEL, injurious reproaches or accusations written and published against the memory of one who is dead, or the reputation of one who is alive, and thereby exposing him to public hatred, contempt, and ridicule.

With regard to libels in general, there are, as in many other cases, two remedies; one by indictment or information, and the other by action. The former for a public offence; for every libel has a tendency to the breach of the peace, by provoking the person libelled to break it; which offence is said to be the same in point of law, whether the matter contained is true or false; and therefore it is that the defendant on an indictment for publishing a libel, is not allowed to allege the truth of it by way of justification. But in the remedy by action on the case, which is to repair the party in damages for the injury done him, the defendant may, as for words spoken, justify the truth of the facts, and shew that the plaintiff has received no injury at all. The chief excellence therefore of a civil action for a libel consists in this, that it not only affords a reparation for the injury sustained, but it is a full vindication of the innocence of the person traduced.

LIBEL, in the ecclesiastical court, is the declaration or charge drawn up in writing, on the part of the plaintiff, to which the defendant is obliged to answer.

LIBEL, in the law of Scotland, signifies an indictment.

LIBELLULA, *dragon-fly*, a genus of insects of the order neuroptera. The generic character is:—mouth furnished with several jaws; antennæ very short; wings four, extended; tail (in the male) hook-forcipated.

The *libellulæ*, or dragon flies, sometimes called by the very improper title of horse-stingers, exhibit an instance scarcely less striking than the butterfly of that strange dis-similitude in point of form under which one and the same animal is destined to appear in the different periods of its existence. Perhaps few persons not particularly conversant in the history of insects, would imagine that these highly brilliant and lively animals, which may be seen flying with such strength and rapidity round the meadows, and pursuing the smaller insects with the velocity of a hawk, had once been inhabitants of the water, and that they had resided for a very long space of time in that element before they assumed their flying form. Of the libellulæ there are about sixty different species, both native and exotic.

LIBERTY, in its most general signification, is said to be a power to do as one thinks fit; unless restrained by the law of the land: and it is well observed, that human nature is ever an advocate for this liberty; it being the gift of God to man in his creation. It is upon that account the laws of England in all cases favour liberty. According to Montesquieu, liberty consists principally in not being compelled to do any thing which the law does not require; because we are governed by civil laws, and therefore we are free, living under those laws.

The absolute rights of man, considered as a free agent, endowed with discernment to know good from evil, and with power of choosing those measures which appear to him to be most desirable, are usually summed up in one general appellation, and denominated the natural liberty of mankind. This natural liberty consists properly in a power of acting as one thinks fit, without any restraint or controul, unless by the law of nature; being a right inherent in us by birth, and one of the gifts of God to man at his creation, when he endowed him with the faculty of free will.

But every man, when he enters into society, gives up a part of his natural liberty, as the price of so valuable a purchase; and in consideration of receiving the advantages of mutual commerce, obliges himself to conform to those laws which the community has thought proper to establish. This species of legal obedience is infinitely more desirable than that wild and savage liberty, which is sacrificed to obtain it. For no man, who considers a moment, would wish to retain the absolute and uncontrouled power of doing whatever he pleases; the consequence of which is, that every other man would also have the same power; and then there would be no security to individuals in any of the enjoyments of life.

Political or civil liberty, therefore, which is that of a member of society, is no other than natural liberty, so far restrained by human laws, and no further, as is necessary and expedient for the general advantage of the public.

Political liberty is distinguished by Mr. Christian from civil liberty, and he defines it to be the security with which, from the constitution, form, and nature of the established government, the subjects enjoy civil liberty. No ideas, continues he, are more distinct than those of civil and political liberty. Yet they are generally confounded; and the latter can

not yet claim an appropriate name. The learned judge (Blackstone) uses political and civil liberty indiscriminately; but it would perhaps be convenient uniformly to use those terms in the respective senses here suggested, or to have some fixed specific denominations for ideas which, in their natures, are so widely different. The last species of liberty has most engaged the attention of mankind, and particularly of the people of England. The people of England have a firm reliance that this civil liberty is secured to them under the constitution of the government.

LIBERTUS, in Roman antiquity, a person who from being a slave, had obtained his freedom. The difference between the liberti and libertini was this: the liberti were such as had been actually made free themselves, and the libertini were the children of such persons.

LIBRA, *the balance*, in astronomy, one of the twelve signs of the zodiac, the sixth in order; so called because when the sun enters it, the days and nights are equal, as if weighed in a balance.

LIBRARY, an edifice or apartment destined for holding a considerable number of books placed regularly on shelves; or, the books themselves lodged in it.

The first who erected a library at Athens was the tyrant Pisistratus, which was transported by Xerxes into Persia, and afterwards brought back by Seleucus Nicanor to Athens. Plutarch says, that under Eumenes there was a library at Pergamus that contained 200,000 books. That of Ptolemy Philadelphus, according to A. Gellius, contained 700,000, which were all burnt by Cæsar's soldiers. Constantine and his successors erected a magnificent one at Constantinople, which in the eighth century contained 300,000 volumes, and among the rest one in which the Iliad and Odyssey were written in letters of gold, on the guts of a serpent; but this library was burnt by order of Leo Isaurus. The most celebrated libraries of ancient Rome were the Ulpian and the Palatine, and in modern Rome, that of the Vatican. The foundation of the Vatican library was laid by Pope Nicholas, in the year 1450; it was afterwards destroyed in the sacking of Rome, by the constable of Bourbon, and restored by Pope Sixtus V. One of the most complete libraries in Europe, is that erected by Cosmo de Medicis; though it is now exceeded by that of the French King, which was begun by Francis I. augmented by Cardinal Richelieu, and completed by M. Colbert. The Emperor's library at Vienna, according to Lambecius, consists of 80,000 volumes, and 15,940 curious medals. The Bodleian library at Oxford exceeds that of any university in Europe, and even those of any of the sovereigns of Europe, except those of the Emperors of France and Germany, which are each of them older by a hundred years. It was first opened in 1602, and has since been increased by a great number of benefactors; indeed the Medicean library, that of Bessarion at Venice, and those just mentioned, exceed it in Greek manuscripts, but it outdoes them all in oriental manuscripts; and as to printed books, the Ambrosian at Milan, and that of Wolfenbuttle, are two of the most famous, and yet both are inferior to the Bodleian. The Cotton library consists wholly of manuscripts, particularly such as relate to the history and antiquities of England; which, as they are now bound, make about 1000 volumes.

In Edinburgh there is a good library belonging to the university, well furnished with books which are kept in good order, and cloistered up with wire doors, that none but the keeper can open. There is also a noble library of books and manuscripts belonging to the gentlemen of the law.

LIBRATION, in astronomy, an apparent irregularity of the moon's motion, whereby she seems to librate about her axis, sometimes from the east to the west, and now and then from the west to the east; so that the parts in the western limb or margin of the moon sometimes recede from the centre of the disk, and sometimes move towards it, by which means they become alternately visible and invisible to the inhabitants of the earth.

Libration *of the earth*, is sometimes used to denote the parallelism of the earth's axis, in every part of its orbit round the sun.

LICENCE, in law, an authority given to a person to do some lawful act.

A licence is a personal power, and therefore cannot be transferred to another. If the person licensed abuse the power given him, in that case he becomes a trespasser.

LICHEN, *liverwort*, a genus of the natural order of algæ, in the cryptogamia class of plants. The male receptacle is roundish, somewhat plain and shining. In the female the leaves have a farina or mealy substance scattered over them. There are about 216 species, all found in Britain. Among the most remarkable are the following:—

L. *rocella*, or orchall, as an article of commerce, is of great importance, being extremely valuable for dying wool or silk any shade of purple or crimson. L. *omphalodes* will dye wool of a brown reddish colour, or a dull but durable crimson, paler and more lasting than that of orchall. L. *Islandicus* is used by the Icelanders in their broth; they also dry it, and make it into bread, &c.

Lichen, in medicine, a *tetter* or *ringworm*, a cutaneous disease, defined by Dr. Willan, "an extensive eruption of papillæ affecting adults, connected with internal disorder usually terminating in scurf, recurrent, not contagious." The Doctor has mentioned five varieties.

LIEUTENANT, an officer who supplies the place, and discharges the office of a superior in his absence. Of these, some are civil, as the lords-lieutenants of kingdoms, and the lords-lieutenants of counties; and others are military, as the lieutenant-general, lieutenant-general of the artillery, lieutenant-colonel, lieutenant of artillery of the Tower, lieutenants of horse, foot, ships of war, &c.

Lieutenant, *lord of Ireland*, is properly a viceroy, and has all the state and grandeur of a king of England, except being served upon the knee. He has the power of making war and peace, of bestowing all the offices under the government, of dubbing knight, and of pardoning all crimes except high treason; he also calls and prorogues the parliament, but no bill can pass without the royal assent. He is assisted in his government by a privy-council; and, on his leaving the kingdom, he appoints the lords of the regency, who govern in his absence.

- **Lieutenants**, *lords of counties*, are officers who, upon any invasion or rebellion, have power to raise the militia, and to give commissions to colonels and other officers, to arm and form them into regiments, troops, and companies. Under the lords-lieutenants are deputy-lieutenants who have the same power; these are chosen by the lords-lieutenants out of the principal gentlemen of each county, and presented to the king for his approbation.

Lieutenant *general*, is an officer next in rank to the general; in battle, he commands one of the wings; in a march, a detachment, or a flying-camp; also a quarter, at a siege, or one of the attacks, when it is his day of duty.

Lieutenant *of a ship of war*, the officer next in rank and power to the captain; of these there are several in a large ship, who take precedence according to the dates of their first commissions.

LIFE-annuities. See **Annuities.**

Life-estates are of two kinds, such as are created by the act of the parties, or such as are created by the operation of the law, as estates by courtesy or dower. 2 Black. 120.

Estates for life, created by deed or grant, are, where a lease is made of lands or tenements to a man, to hold for the term of his own life, or for that of another person, or for more lives than one; in any of which cases, he is called tenant for life; only when he holds the estate by the life of another, he is usually termed tenant pour auter vie, for another's life.

LIGAMENT. See **Anatomy.**

LIGATURE. See **Surgery.**

LIGHT. See **Optics.**

Light, *instantaneous*. An apparatus of a very simple construction has recently been offered to the public, which may be said to be free from all those objections to which the various contrivances hitherto invented for this purpose are more or less liable. The fire-boxes, although certainly superior to the phosphorus boxes, are very liable to be out of order, both by their imbibing moisture from the atmosphere, and the dispersion of the acid; but in the newly invented instantaneous light apparatus no kind of inconvenience or danger can occur, except by the most inexcusable negligence.

The following is a description of this useful instrument, as fitted up in its simplest form by Mr. Garden, operative chemist, London. A and B, fig. 1, plate XXVII, are two glass vessels fitted together by grinding the upper one at the neck, which is open at the top and furnished with a perforated stopper, to prevent the spilling of the acid, and also to permit the free entrance and escape of atmospheric air. The lower extremity of this vessel terminates in an open tube which reaches nearly to the bottom of the vessel B. The vessel B is provided with a side opening, to which are attached a brass cap with a stop-cock and jet, and also a small immoveable cup fixed to a wire, which slides in a collar fixed upon the stop-cock; the use of this collar is to afford the means of adjusting the cup at different distances from the orifice of the jet, which will occasionally become necessary, A the quantity of gas in the apparatus varies. as little experience will best teach the art of this adjustment.

The glass tube of the vessel A carries a cylinder of zinc, *a e* which is supported by a piece of cork fitted to the extremity of the tube

To charge and use the apparatus. Fill the lower glass B up to the part marked by the dotted line with diluted sulphuric acid (made by mixing together, in a stone-ware jug, one ounce, by measure, of sulphuric acid, sp. gr. 1850, with a wine pint of water), and connect the upper one with it, as represented in the figure, closing at the same time the stop-cock *y*; gas will now begin to be formed, in consequence of the action of the acid upon the metal *a e*, which surrounds the glass tube *a b*, and will occupy the lower part of the vessel B, causing the liquid to ascend into A, until one surface of the liquid appears near the part shewn by the elliptical line, and the other at a level with the bottom of the metallic cylinder *a e*. In this state the apparatus is ready for use.

If the stop-cock *y* be now opened, a stream of gas will issue from the orifice of the jet *c*; and falling into the cup *d* (which contains a fragment or two of spongy platina for igniting the gas), will quickly be kindled, and burn with a pale lambent flame, at which a piece of paper or a wax taper may instantly be lighted: the cock is then to be closed. If the experiment of thus inflaming portions of the gas be frequently and quickly repeated, a part of the liquid, which had been raised into A by the elasticity of the gas produced in B, will be found to have again descended, and this quantity will be equal to that of the gas which has escaped by the jet *c*; but as the liquid which has in this manner descended into the lower vessel will come into contact with a portion of the metallic cylinder, a new portion of gas will speedily be produced, and occasion the return of a corresponding portion of liquid into the upper vessel. In this manner the instrument will continue to replenish itself, and will never cease to furnish a regular and steady supply of gas until the whole of the acid liquor becomes saturated with metal, and can dissolve no more, or until all the metal be dissolved; neither of these circumstances however can happen for a considerable time, even with frequent and daily use. It may be proper to mention, that the cup *d*, which contains the igniting substance, should always, when not in use, be carefully closed by its cover, so as to prevent the contact of moisture or particles of dust; but if, by any accident, it should acquire damp, and lose the power of inflaming the gas, it may generally be restored by heating it upon the blade of a knife over the clear flame of a candle, or still better over that of a spirit lamp; if this does not succeed, it must be rejected, and a fresh portion from the small vial substituted in its place.

After long and continued use, the small orifice of the jet *c* will be liable to become partially closed up, by the action of the burning gas, or the accidental accession of particles of dust; but this may be remedied in a moment, by unscrewing the jet and passing through it a fine sewing needle, as shewn in the enlarged sketch of the jet, fig. 2.

Light *from plants*. In Sweden a very curious phenomena has been observed on certain flowers by M. Haggern, lecturer on natural history. One evening he perceived a faint flash of light repeatedly dart from a marigold. Surprised at the appearance, he resolved to examine it with attention; and, to be assured it

was no deception of the eye, he placed a man near him, to make a signal at the moment when he observed the light. They both saw it constantly at the same moment. The light was most brilliant on marigolds of an orange or flame colour; but scarcely visible on pale ones. To discover whether some little insects or phosphoric worms might not be the cause of this appearance, the flowers were carefully examined, even with a microscope, without any such thing being found. From the rapidity of the flash, and other circumstances, it may be inferred that there is something of electricity in this phenomenon.

LIGHTFOOTIA, a genus of the class and order polygamia dioecea. The calyx is four-leaved; cor. none; fem. and her. stigma sessile; berry umbilicated. There are three species, shrubs of the E. Indies.

LIGHT-HOUSE, a building erected upon a cape or promontory on the sea-coast, or upon some rock in the sea, and having on its top in the night-time a great light formed by lamps, constantly attended by some careful person, so as to be seen at a great distance from the land. It is used to direct the shipping on the coast, that might otherwise run a-shore, or steer an improper course, when the darkness of the night and the uncertainty of currents, &c. might render their situation with regard to the shore extremely doubtful.

LIGHTNING, the name given to those explosions of electricity that take place in the atmosphere during a thunder-storm. See ELECTRICITY.

LIGHTS: stopping lights of any house is a nuisance, for which an action will lie, if the house is an ancient house, and the lights ancient lights: but stopping a prospect is not, being only matter of delight, not of necessity.

LIGUSTICUM, *lovage*; a genus of the digynia order, in the pentandria class of plants; and in the natural method ranking under the 45th order, umbellatæ. There are eight species, of which the most remarkable are, the levisticum, or common, and the Scoticum, or Scots, lovage. The first is a native of the Appenine mountains in Italy. The second is a native of Scotland, and grows near the sea in various parts of the country.

LIGUSTRUM, *privet*, a genus of the monogynia order, in the diandria class of plants; and in the natural method ranking under the 44th order, sepiariæ. Of the common there are two varieties, the deciduous and the evergreen. They are hardy plants, rising from ten to fifteen feet high. They are easily propagated by seed, layers, suckers, or cuttings. They are used for making hedges. The purple colour upon cards is prepared from the berries. The leaves are bitter and slightly astringent. Oxen, goats, and sheep, eat the plant; horses refuse it.

LIKE, in geometry, &c. denotes the same with similar.

LILAC, in botany, a genus of trees, otherwise called syringa. See SYRINGA.

LILATE, the mineral LEPIDOLITE.

LILIUM, the *lily*; a genus of the monogynia order, in the hexandria class of plants, and in the natural method ranking under the 10th order, coronariæ. The corolla is hexapetalous, and campanulated; the capsules connected by small cancellated hairs. There are eleven species; all of them bulbous-rooted, herbaceous, flowery perennials, rising with erect annual stalks three or four feet high, garnished with long narrow leaves, and terminated by fine clusters of bell-shaped, hexapetalous flowers of great beauty.

LIMAX, the *slug*, or naked snail; a genus of insects belonging to the order of vermes mollusca. The body is oblong, fitted for crawling, with a kind of muscular coat on the upper part, and the belly is plain. They have four tentacula, or horns, situated above the mouth, which they extend or retract at pleasure. This reptile is always destitute of shell; but besides that, its skin is more clammy, and of a greater consistency, than that of the snail: the black naked slug has a furrowed cloak, almost as thick and as hard as leather, under which it withdraws its head as within a shell. There are eight species, distinguished entirely by their colour; as the black slug, the white slug, the reddish slug, the ash-coloured slug, &c. The black slug is hermaphrodite. A black slug, powdered over with snuff, salt, or sugar, falls into convulsions, casts forth all its foam, and dies.

LIME, one of those earthly substances, which exist in every part of the known world. It is found purest in lime-stone, marble and chalk. None of these substances are lime, but are capable of becoming so by burning in a white heat. Pure lime is of a white colour, moderately hard, but easily reduced to a powder. If water be poured on newly-burnt lime, it swells and falls to pieces, and is soon reduced to a very fine powder. In the mean time so much heat is produced, that part of the water flies off in vapour. If the quantity of lime slacked be great, the heat produced is sufficient to set fire to combustibles. In this manner, vessels loaded with lime have sometimes been burnt. When great quantities of lime are slacked in a dark place, not only heat but light also is emitted, as Mr. Pelletier has observed. When slacked lime is weighed, it is found to be heavier than it was before. This additional weight is owing to the combination of part of the water with the lime. The smell perceived during the slacking of lime is owing to a part of that earth being elevated along with the vapour of the water; as evidently appears from this circumstance, that vegetable blues exposed to this vapour are converted to green. Limestone and chalk, though they are capable of being converted into lime by burning, possess hardly any of the properties of that active substance. They are tasteless, scarcely soluble in water, and do not perceptibly act on animal bodies.

Lime is not acted on by light, neither does it combine with oxygen. Sulphur and phosphorus are the only simple combustibles with which it unites.

Lime does not combine with alkalis. The affinities of lime are arranged by Bergmann in the following order

Oxalic acid
Sulphuric
Tartaric
Succinic
Phosphoric
Saclactic
Nitric
Muriatic
Suberic
Fluoric
Arsenic
Lactic
Citric
Benzoic
Sulphurous
Acetic
Boracic
Carbonic
Prussic

Quicklime, in the act of becoming mild, prepares soluble out of insoluble matter. It is upon this circumstance that the operation of lime in the preparation for wheat crops depends; and its efficacy in fertilizing peats, and in bringing into a state of cultivation all soils abounding in hard roots or dry fibres, or inert vegetable matter.

The solution of the question, whether quicklime ought to be applied to a soil, depends upon the quantity of inert vegetable matter that it contains. The solution of the question, whether marle, mild lime, or powdered limestone, ought to be applied, depends upon the quantity of calcareous matter already in the soil. All soils are improved by mild lime, and ultimately by quicklime, which do not effervesce with acids; and sands more than clays.

When a soil, deficient in calcareous matter, contains much *soluble* vegetable manure, the application of quicklime should always be avoided, as it either tends to decompose the soluble matters by uniting to their carbon and oxygen so as to become mild lime, or it combines with the soluble matters, and forms compounds having less attraction for water than the pure vegetable substance.

The case is the same with respect to most animal manures; but the operation of the lime is different in different cases, and depends upon the nature of the animal matter. Lime forms a kind of insoluble soap with oily matters, and then gradually decomposes them by separating from them oxygen and carbon. It combines likewise with the animal acids, and probably assists their decomposition by abstracting carbonaceous matter from them combined with oxygen; and consequently it must render them less nutritive. It tends to diminish likewise the nutritive powers of albumen from the same causes; and always destroys, to a certain extent, the efficacy of animal manures, either by combining with certain of their elements, or by giving to them new arrangements. Lime should never be applied with animal manures, unless they are too rich, or for the purpose of preventing noxious effluvia. It is injurious when mixed with any common dung, and tends to render the extractive matter insoluble.

In those cases in which fermentation is useful to produce nutriment from vegetable substances, lime is always efficacious, as with tanners' bark.

There are two modes in which lime acts as a cement: in its combination with water, and in its combination with carbonic acid.

When quicklime is rapidly made into a paste with water, it soon loses its softness, and the water and the lime form together a solid coherent mass, which consists of one part of water to three parts of lime. When hydrate of lime, whilst it is consolidating, is mixed with red oxide of iron, alumina, or silica, the mixture becomes harder, and more coherent than when lime alone is used; and it appears that this is owing to a certain degree of chemical attraction between hydrate of lime and these bodies; and they render it less liable to decompose by the action of the carbonic acid in the air, and less soluble in water.

The basis of all cements that are used for works which are to be *covered with water*, must be formed from hydrate of lime; and the lime made from impure limestones answers this purpose very well. Puzzolana is composed principally of silica, alumina, and oxide of iron; and it is used mixed with lime to form cements intended to be employed under water. Mr. Smeaton, in the construction of the Eddystone light-house, used a cement composed of equal parts by weight of slacked lime and puzzolana. Puzzolana is a decomposed lava.

Tarras, which was formerly imported in considerable quantities from Holland, is a mere decomposed basalt: two parts of slacked lime and one part of tarras form the principal part of the mortar used in the great dykes of Holland. Substances which will answer all the ends of puzzolana and tarras are abundant in the British Islands. An excellent red tarras may be procured in abundance from the Giant's Causeway; and decomposing basalt is abundant in many parts of Scotland, and also in the northern districts of England in which coal is found.

Parker's cement, and cements of the same kind made at the alum works of Lord Dundas, and Lord Mulgrave, are mixtures of calcined ferruginous, siliceous, and aluminous matter, with hydrate of lime. See Cement.

The cements which act by combining with carbonic acid, or the common mortars, are made by mixing together slacked lime and sand. These mortars at first solidify as hydrates, and are slowly converted into carbonate of lime by the action of the carbonic acid of the air. Mr. Tennant found that a mortar of this kind, in three years and a quarter, had regained 63 per cent. of the carbonic acid gas, which constitutes the definite proportion of carbonate of lime. The rubbish of mortar from houses owes its power to benefit lands principally to the carbonate of lime it contains, and the sand in it; and its state of cohesion renders it particularly fitted to improve clayey soils. The hardness of the mortar in very old buildings, depends upon the perfect conversion of all its parts into carbonate of lime. The purest limestones are the best adapted for making this kind of mortar: the magnesian limestones make excellent water cements, but act with too little energy upon carbonic acid gas to make good common mortar.

The Romans, according to Pliny, made their best mortar a year before it was used; so that it was partially combined with carbonic acid gass before it was employed.

In burning lime there are some particular precautions required for the different kinds of limestones. In general, one bushel of coal is sufficient to make four or five bushels of lime. The magnesian limestone requires less fuel than the common limestone. In all cases in which a limestone containing much aluminous or siliceous earth is burnt, great care should be taken to prevent the fire from becoming too intense; for such lime easily vitrifies, in consequence of the affinity of lime for silica and alumina. And as in some places there are no other limestones than such as contain other earths, it is important to attend to this circumstance. A moderately good lime may be made at a low red heat; but it will melt into a glass at a white heat. In limekilns for burning such lime, there should be always a damper.

In general, when limestones are not magnesian, their purity will be indicated by their

loss of weight in burning; the more they lose, the larger is the quantity of calcareous matter they contain. The magnesian limestones contain more carbonic acid than the common limestones; and all of them lose more than half their weight by calcination.

Lime-kilns, are buildings in which limestone is converted into lime by the operation of heat.

Limestone, is the native indurated carbonate of lime; it is usually more or less bluish from the presence of iron; and of a granulated fracture.

LIMIT, in a restrained sense, is used by mathematicians for a determinate quantity to which a variable one continually approaches. In algebra, the term limits is applied to two quantities, one of which is greater, and the other less, than another quantity.

LIMITATION, a certain time prescribed by statute, within which an action must be brought. The time of limitation is twofold; first in writs, by divers acts of parliaments; secondly to make a title to any inheritance, and that is by the common law.

Limitation on penal statutes. All actions, suits, bills, indictments, or informations, for any forfeiture limited to the king, his heirs or successors only, shall be brought within two years after the offence committed, and not after; and all actions, &c. except the statutes of tillage, the benefit and suit whereof is or shall be by the said statute limited to the king, his heirs, or successors, shall be brought by any person that may lawfully sue for the same, within one year next after the offence committed; and in default of such pursuit, then the same shall be brought for the king's majesty, his heirs or successors, any time within the two years, after that year is ended: and it is provided, that where a shorter time is limited by any penal statute, the prosecution must be within that time.

All actions of trespass, of assault, battery, wounding, imprisonment, or any of them, are to be commenced within four years next after the cause of such actions or suits, and not after. All actions of trespass, *quare clausum fregit;* all actions of trespass, detinue, trover, and replevin; all actions of account, and upon the case, (other than such accounts as concern the trade of merchandise between merchant and merchant;) all actions of debt, grounded upon any lending, or contract without speciality, (that is, not being by deed or under seal;) all actions of debt for arrearages of rent; and all actions of assault, menace, battery, wounding, and imprisonment, shall be commenced within the time and limitation as followeth, and not after: that is to say, the said actions upon the case (other than for slander,) and the said actions for account, and the said actions for trespass, debt, detinue, and replevin, and the said action for trespass *quare clausum fregit*, within six years after the cause of such action. In all these statutes there is an exception in relation to infants, lunatics, and femes coverts, allowing them a further time after they are in a situation which enables them to sue. As to the exception with respect to merchants' accounts, it extends to actions on accounts current only, in which the giving credit on one side is an acknowledgment of the debt on the other; but when the account is settled between merchant and merchant, it must be sued for like any other debt; and if all the articles are on one side, the account is not taken out of the statute. An acknowledgment of the debt prevents the operation of the statute of limitations, and also a payment upon account: but as it is convenient that suits should not be delayed so long that vouchers cannot be produced, settlements should regularly be enforced. A writ also may be sued out to save the statute of limitation, as it is called, and though never sued, yet if it is regularly entered, and continued upon the record, the suit may be effectually prosecuted long after, and being commenced within time, the action may be maintained out. This is in conscience rather a mode of evading the statute.

LIMNING, the art of painting in water colours, in contradistinction to painting which is done in oil colours. See Painting.

LIMODORUM, a genus of the gynandria diandria class of plants, the flower of which consists of five oblong petals, and the nectarium hollow, and formed of a single leaf: the fruit is a columnar unilocular capsule, containing a great number of very small seeds. There are thirteen species, bulbs of America, &c.

LIMONIA, a genus of the decandria monogynia class and order. There are seven species, trees of the East Indies, &c.

LIMOSELLA, a genus of the didynamia angiospermia class of plants: the flower consists of one erect petal, divided into five segments; fruit is an unilocular capsule, with a great many seeds. Two species, annuals of the Cape.

LINCONIA, a genus of the class and order pentandria digynia. There is one species, a shrub of the Cape.

LINDERA, a genus of the class and order hexandria monogynia. There is one species, a shrub of Japan.

LINDERNIA, a genus of the class and order didynamia angiospermia. There are three species, annuals of America.

LINE, in geometry, a quantity extending in length only, without any breadth or thickness. It is formed by the flux or motion of a point. See Fluxion and Geometry.

Lines, considered as to their positions, are either parallel, perpendicular, or oblique, the construction and properties whereof see under Parallel, &c.

Lines, in perspective, are, 1, Geometrical line, which is a right line drawn in any manner on the geometrical plane. 2. Terrestrial line, or fundamental line, is a right line wherein the geometrical plane, and that of the picture or draught, intersect one another.

Line of direction on the earth's axis, in the Pythagorean system of astronomy, the line connecting the two poles of the ecliptic and of the equator, when they are projected on the plane of the former.

Line of direction. See Mechanics.

Line of gravitation of any heavy body, a line drawn through its centre of gravity, and according to which it tends downwards.

Lines on the plain scale, are the line of chords, line of sines, line of tangents, line of secants, line of semitangents, line of leagues; the construction and application of which see under the words Scale, Sailing, &c.

LINES on Gunter's scale. See GUNTER'S SCALE.

LINES, in fortification, are those of approach, capital, defence, circumvallation, contravallation of the base, &c.

To LINE a work, signifies to strengthen a rampart with a firm wall: or to encompass a parapet or moat with good turf, &c.

LINE, in the art of war, is understood of the disposition of an army, ranged in order of battle, with the front extended as far as may be, that it may not be flanked.

LINE *of battle*, is also understood of the disposition of a fleet on the day of engagement.

Ship of the LINE, a vessel large enough to be drawn up in the line, and to have a place in a sea-fight.

LINE, also denotes a French measure, containing the twelfth part of an inch, or the hundred and forty-fourth part of a foot.

LINEAR NUMBERS in mathematics, such as have relation to length only: such is a number which represents one side of a plane figure.

LINEAR PROBLEM, that which may be solved geometrically, by the intersection of two right lines.

LINEN, in commerce, a well known kind of cloth, chiefly made of flax.

LING. See GADUS.

LINNÆA, a genus of the class and order didynamia angiospermia. The cal. is double; the cor. bell-shaped; the berry dry, three-celled. There is one species, an herb of Sweden.

LINNET. See FRINGILLIA.

LINSEED, the seed of the plant linum. See LINUM.

LINSPINS, in the military art, small pins of iron, which keep the wheel of a cannon or waggon on the axle-tree, to keep the wheel from falling off.

LINSTOCK, in the military art, a wooden staff, about three feet long, upon one end of which is a piece of iron which divides in two, turning from one another, having each a place to receive a match, and a screw to keep it fast. The other end is pointed, and shod with iron, to stick in the ground. It is used by gunners to light the port-fire at, with which the guns are fired.

LINT, *linum*, from the flux of which linen is made.

In surgery, the term lint denotes the scrapings of linen used in dressing wounds, and made up in various forms, as tents, dossils, pledgets, &c.

LINUM, in botany, *flax*, a genus of the pentandria pentagynia class and order, natural order of gruinales. Essential character:—calyx five-leaved; petals five; capsule ten-valved, ten-celled; seeds solitary. There are twenty-five species. The several species of flax are mostly herbaceous, some are fruticose, or woody at bottom; two are shrubby, and one arboreous; leaves generally alternate; flowers solitary and axillary; corolla commonly blue, sometimes fading to white, and in some yellow. Flax is found wild in many parts of Europe, in corn fields; in England it is, perhaps, doubtful whether it be aboriginal. It is common in the western counties, not only in corn-fields, but in pastures and on downs.

LION. See FELIS.

LIONCELLES, in heraldry, a term used for several lions borne in the same court of arms.

LIP, *hare*, a disorder in which the upper lip is in a manner slit or divided, so as to resemble the upper lip of a hare, whence the name.

LIPPIA, a genus of the didynamia gymnospermia class and order. The cal. is four-toothed; the caps. one-celled, three-valved, two-seeded; seed one, two-celled. There are five species, shrubs of America.

LIQUEFACTION. See FLUIDITY.

LIQUOR *of flints*. Alkalis have a powerful action on silica: they combine in different proportions; two or three parts of potash, with one of silica, give a compound, which is deliquescent in the air, and soluble in water. This was formerly distinguished by the name of liquor of flints, but it is now denominated silicated alkali.

LIQUORICE. See GLYCIRRHIZA.

LIRIODENDRON, the *tulip tree*, a genus of the polygynia order, in the polyandria class of plants; and in the natural method ranking under the 52d order, coadunatæ. The calyx is triphyllous; there are nine petals; and the seeds imbricated in such a manner as to form a cone. There are two species, viz. L. tulipifera, common tulip tree; and L. lillifera; the former is a native of North America, where it is a tree of the first magnitude, and is generally known in all the English settlements by the name of poplar.

LIST, in commerce, the border of cloth or stuff, serving not only to shew their quality, but to preserve them from being torn in the operation of fulling, dyeing, &c. List is used for a variety of purposes, but chiefly by gardeners for securing their wall-trees.

LITA, a genus of the class and order pentandria monogynia. There are two species, herbs of Guiana.

LITERARY *property*. Authors, it should seem had, by the common law, the sole and exclusive copyright remaining in themselves or their assigns in perpetuity, after having printed and published their compositions. This, as a common law right, was strangely questioned by some of our judges, who studied special pleading more than common sense. But by statute 8 Anne, c. 19, it is secured to them for fourteen years, from the day of publishing; and after the end of fourteen years, the sole right of printing or disposing of copies, shall return to the authors, if then living, for other fourteen years. This statute, it has been held, restrains the right of the author and his assigns to the fourteen or the twenty-eight years, whatever it might have been at the common law. A penalty on each sheet found in the possession of a party pirating a work, is inflicted by the statute, 9, Anne, c. 19; and, in order to entitle the plaintiff to recover this penalty, the book must have been entered at Stationers' Hall. But an author whose work has been pirated, may maintain an action for damages merely without having so entered his book. When an author transfers all his right or interest in a publication to another, and happens to survive the first fourteen years, the second term will result to his assignee, and not to himself.

LITHARGE, an oxide of lead. See LEAD.

LITHIA. A new alkali. It was discovered by M. Arfredson, a young chemist of great

merit, employed in the laboratory of M. Berzelius. It was found in a mineral from the mine of Uten in Sweden, called *petalite* by M. D'Andrada, who first distinguished it. Sir H. Davy demonstrated by voltaic electricity, that the basis of this alkali is a metal, to which the name of *lithium* has been given.

Lithia may be obtained by fusing petalite with potash, dissolving the whole in muriatic acid, evaporating to dryness, and digesting in alcohol. The muriate of lithia being very soluble in that fluid, is taken up, while the other salts remain. By a second evaporation and solution in alcohol, it is obtained perfectly pure. The muriate is itself a salt very characteristic of the alkali. It may easily be decomposed by carbonate of silver; and the carbonate thus procured, when treated with lime, yields pure lithia. Caustic lithia has a very sharp burning taste. It destroys the cuticle of the tongue like potash. It does not dissolve with great facility in water, and appears not to be much more soluble in hot than in cold water. In this respect it has an analogy to lime. Heat is evolved during its solution in water. When exposed to the air it does not attract moisture, but absorbs carbonic acid, and becomes opaque. When exposed for an hour to a white heat in a covered platinum crucible, its bulk does not appear to be diminished; but it has absorbed a quantity of carbonic acid.

LITHIC-*acid*. This was discovered about the year 1776 by Scheele, in analyzing human calculi, of many of which it constitutes the greater part, and of some, particularly that which resembles wood in appearance, it forms almost the whole. It is likewise present in human urine, and in that of the camel; and Dr. Pearson found it in those arthritic concretions commonly called chalkstones, which Mr. Tennant has since confirmed. It is often called *uric* acid.

The following are the results of Scheele's experiments on calculi, which were found to consist almost wholly of this acid. 1. Dilute sulphuric acid produced no effect on the calculus, but the concentrated dissolved it; and the solution, distilled to dryness, left a black coal, giving off sulphurous acid fumes. 2. The muriatic acid, either diluted or concentrated, had no effect on it even with ebullition. 3. Dilute nitric acid attacked it cold; and with the assistance of heat produced an effervescence and red vapour, carbonic acid was evolved, and the calculus was entirely dissolved. The solution was acid, even when saturated with the calculus, and gave a beautiful red colour to the skin in half an hour after it was applied; when evaporated, it became of a blood-red, but the colour was destroyed by adding a drop of acid: it did not precipitate muriate of barytes, or metallic solutions, even with the addition of an alkali; alkalis rendered it more yellow, and if superabundant, changed it by a strong digest- [illegible] of copper green, nitrate of silver grey, superoxygenated muriate of mercury, and solutions of lead and zinc, white. Lime water produced in the nitric solution a white precipitate, which dissolved in the nitric and muriatic acids without effervescence, and without destroying their acidity. Oxalic acid did not precipitate it. 4. Carbonate of potash did not dissolve it, either cold or hot, but a solution of perfectly pure potash dissolved it even cold. The solution was yellow; sweetish to the taste; precipitated by all the acids, even the carbonic; did not render lime water turbid; decomposed and precipitated solution of iron brown, of copper grey, of silver black, of zinc, mercury, and lead, white; and exhaled a smell of ammonia. 5. About 200 parts of lime water dissolved the calculus by digestion, and lost its acrid taste. The solution was partly precipitated by acids. 6. Pure water dissolved it entirely, but it was necessary to boil for some time 360 parts with one of the calculus in powder. This solution reddened tincture of litmus, did not render lime water turbid, and on cooling deposited in small crystals almost the whole of what it had taken up. 7. Seventy-two grains distilled in a small glass retort over an open fire, and gradually brought to a red heat, produced water of ammonia mixed with a little animal oil, and a brown sublimate, weighing 28 grains, and 12 grains of coal remained, which preserved its black colour on red-hot iron in the open air.

LITHOMARGE, in mineralogy, is a species of the clay genus, and divided by Werner and others into two sub-species, viz. the friable and the indurated. Friable lithomarge or rock-marrow is white and massive; it occurs likewise as a crust, and disseminated. Its lustre is feebly glimmering, is generally coherent, feels greasy, and adheres to the tongue. It is found in large quantities in the Saxon tin veins. Indurated lithomarge is commonly white, but with many varieties of colour. It is found in many parts of Germany, and occurs in veins of porphyry, gneiss, and serpentine.

LITHOTOMY, in surgery, the operation by which a calculus is removed from the bladder.

LITMUS, in chemistry, a substance, the tincture of which is extremely useful, as a test of the presence of an acid or alkali. All acids and salts, with an access of acid, change the natural violet purple of litmus to red; when reddened by an acid, the blue is restored by an alkali.

LITURGY, a name given to those set forms of prayer which have been generally used in the Christian church. Of these there are not a few ascribed to the apostles and fathers, but they are almost universally allowed to be spurious.

LIVER, in anatomy, a very large viscus, of a red colour, situated in the right hypochondrium, and serving for the secretion of the bile or gall. See ANATOMY.

LIVERY, in matters of dress and equipage, a certain colour and form of dress by which noblemen and gentlemen choose to distinguish their servants.

LIVERY *of seisin*, a delivery of possession of lands, tenements, or other corporeal thing (for of things incorporeal there can be no seisin) to one that has right.

Livery of seisin must be on the land in the presence of two witnesses, and was anciently used to give publicity to gifts or transfers of land. It is now necessary, in order to complete a feoffment, and to make good a lease for life or grant of the freehold to commence at a future day. See ESTATE, LEASE. Where there is land and a house, it must be made in the house that being the principal.

LIVERYMEN, of London, are a number of men chosen from among the freemen of each company. Out of this body the common council, sheriff, and other superior officers for the government of the city are elected, and they alone have the privilege of giving their votes for members of parliament; from which the rest of the citizens are excluded.

LIVES, or insurance of Lives. See Insurance, and Life.

LIZARD. See Lacerta.

LOAD, or Lode, in mining, a word used, especially in the tin-mines, for any regular vein or course, whether metallic or not; but most commonly load means a metallic vein.

LOAMS. See Agriculture.

LOANS, in political economy, sums of money, generally of large amount, borrowed from individuals or public bodies, for the service of the state. They are either compulsory, in which case they may be more properly termed requisitions; or voluntary, which is the only mode that can be frequently resorted to with advantage. Loans are sometimes furnished by public companies as a consideration for peculiar privileges secured to them; but are much more commonly advanced by individuals on a certain interest being allowed for the use of the money, either for a term of years, or until the principal shall be repaid.

The practice of borrowing money, for defraying part of the extraordinary expences in time of war, had been adopted in other countries long before it was introduced into Great Britain; but it has been carried to a far greater extent here than in any other state; and the facility with which the government has been enabled to raise the largest sums, has arisen entirely from the strict punctuality with which it has constantly made good all pecuniary engagements. The chancellor of the exchequer is the officer who usually conducts negociations of this kind on the part of the government, and the agreement is, afterward confirmed by parliament.

LOBE, in anatomy, any fleshy protuberant part, as the lobes of the lungs, lobes of the ears, &c.

LOCAL, in law, something fixed to the freehold, or tied to a certain place; thus, real actions are local, since they must be brought in the country where they lie, and local customs are those peculiar to certain countries and places.

Local *problem*, among mathematicians, such a one as is capable of an infinite number of different solutions, by reason that the point which is to resolve the problem may be indifferently taken within a certain extent.

LOCK, a well-known instrument, and reckoned the masterpiece in smithery; a great deal of art and delicacy being required in contriving and varying the wards, springs, bolts, &c. and adjusting them to the places where they are to be used, and to the various occasions of using them. From the various structure of locks, accommodated to their different intentions, they acquire various names. Those placed on outer doors are called stock-locks; those on chamber doors, spring locks; those on trunks, trunk-locks, padlocks, &c. Of these the spring-lock is the most considerable, both for its frequency and the curiosity of its structure.

A treatise upon this subject has been published by Mr. Joseph Bramah, who begins with observing, that the principle on which all locks depend, is the application of a lever to an interior bolt, by means of a communication from without; so that, by means of the latter, the lever acts upon the bolt, and moves in such a manner as to secure the lid or door from being opened by any pull or push from without. The security of locks in general, therefore, depends on the number of impediments we can interpose betwixt the lever (the key) and the bolt which secures the door; and these impediments are well known by the name of wards, the number and intricacy of which alone are supposed to distinguish a good lock from a bad one. If these wards, however, do not in an effectual manner preclude the access of all other instruments besides the proper key, it is still possible for a mechanic of equal skill with the lockmaker to open it without the key, and thus to elude the labour of the other. "As nothing (says Mr. Bramah) can be more opposite in principle to fixed wards than a lock which derives its properties from the motion of all its parts, I determined that the construction of such a lock should be the subject of my experiment." In the prosecution of this experiment, he had the satisfaction to find that the least perfect of all his models fully ascertained the truth and certainty of his principle. The exclusion of wards made it necessary to cut off all communication between the key and the bolt; as the same passage which (in a lock simply constructed) would admit the key, might give admission likewise to other instruments. The office, therefore, which in other locks is performed by the extreme point of the key, is here assigned to a lever, which cannot approach the bolt till every part of the lock has undergone a change of position.

Lock, or, **Wier**, in inland navigations, the general name for all those works of wood or stone, made to confine and raise the water of a river. But the term lock is more particularly appropriated to express a kind of canal inclosed between two gates; the upper called by workmen the sluice-gate, and the lower called the flood-gate. These serve in artificial navigations to confine the water, and render the passage of boats easy in passing up and down the stream.

LOCUS *geometricus*, denotes a line by which a local or indeterminate problem is solved.

A locus is a line, any point of which may equally solve an indeterminate problem. Thus, if a right line suffice for the construction of the equator, it is called *locus ad rectum.* If a circle, *locus ad circulum:* if a parabola, *locus ad parabolam:* if an ellipsis, *locus ad ellipsin:* and so of the rest of the conic sections.

LOCUST. See Gryllus.

LODGMENT, in military affairs, is a work raised with earth, gabions, fascines, woolpacks, or mantelets, to cover the besiegers from the enemy's fire, and to prevent their losing a place which they have gained, and are resolved, if possible, to keep.

LOG, in naval affairs, is a flat piece of wood shaped somewhat like a flounder, with a piece of lead fastened to its bottom, which makes it stand or swim upright in the water. To this log is fastened a long line, called the log-line; and this is commonly divided into certain

spaces fifty feet in length by knots, which are pieces of knotted twine inreeved between the strands of the line; which shew, by means of a half-minute glass, how many of these spaces or knots are run out in half a minute. They commonly begin to be counted at the distance of about 10 fathoms or 60 feet from the log; so that the log, when it is hoven overboard, may be out of the eddy of the ship's wake before they begin to count: and for the ready discovery of this point of commencement, there is commonly fastened at it a red rag.

The log being thus prepared, and hoven over board from the poop, and the line veered out by the help of a reel, as fast as the ship sails from it, will shew how far the ship has run in a given time, and consequently her rate of sailing. Hence it is evident, that as the distance of the knots bears the same proportion to a mile as half a minute does to an hour, whatever number of knots the ship runs in half a minute, the same number of miles she will run in an hour.

Log-board, a table generally divided into five columns, in the first of which is entered the hour of the day; in the second the course steered; in the third the number of knots run off the reel each time of heaving the log; in the fourth, from what point the wind blows; and in the fifth, observations on the weather, variation of the compass, &c.

Log-book, a book ruled in columns like the log-board, into which the account on the log-board is transcribed every day at noon.

LOGARITHMS are numbers so contrived and adapted to other numbers, that the sums and differences of the former shall correspond to, and shew the products and quotients of the latter.

Or, more generally, logarithms are the numerical exponents of ratios; or a series of numbers in arithmetical progression, answering to another series of numbers in geometrical progression. Thus,

0, 1, 2, 3, 4, 5, Indices, or logarithms.
1, 2, 4, 8, 16, 32, Geometric progression.

Or,

0, 1, 2, 3, 4, 5, Indices, or logarithms.
1, 3, 9, 27, 81, 243, Geometric progression

Or,

0, 1, 2, 3, 4, 5, Ind. or log.
1, 10, 100, 1000, 10000, 100000, Geo. pro.

Where it is evident that the same indices serve equally for any geometric series; and consequently there may be an endless variety of systems of logarithms to the same common numbers, by only changing the second term, 2, 3, or 10, &c. of the geometrical series.

It is also apparent, from the nature of these series, that if any two indices be added together, their sum will be the index of that number which is equal to the product of the two terms, in the geometric progression, to which those indices belong.

Thus, the indices 2 and 3, being added together, are = 5; and the numbers 4 and 8, or the terms corresponding with those indices, being multiplied together, are = 32, which is the number answering to the index 5.

And, in like manner, if any one index be subtracted from another, the difference will be the index of that number, which is equal to the quotient of the two terms to which those indices belong.

Thus the index 6, minus the index 4, is = 2; and the terms corresponding to those indices are 64 and 16, whose quotient is = 4; which is the number answering to the index 2.

For the same reason, if the logarithm of any number is multiplied by the index of its power, the product will be equal to the logarithm of that power.

Thus, the index or logarithm of 4, in the above series, is 2; and if this number is multiplied by 3, the product will be = 6; which is the logarithm of 64, or the third power of 4.

And if the logarithm of any number is divided by the index of its root, the quotient will be equal to the logarithm of that root.

Thus, the index or logarithm of 64 is 6; and if this number is divided by 2, the quotient will be = 3; which is the logarithm of 8 or the square root of 64.

The logarithms most convenient for practice are such as are adapted to a geometric series, increasing in a tenfold proportion, as in the last of the above forms, and are those which are to be found, at present, in most of the common tables upon this subject.

The distinguishing mark of this system of logarithms is, that the index, or logarithm, of 1 is 0; that of 10, 1; that of 100, 2: that of 1000, 3, &c. And in decimals the logarithms of 1 is —1 that of .01, —2; that of .001, 3, &c.

From whence it follows that the logarithm of any number between 1 and 10 must be 0 and some fractional parts, and that of a number between 10 and 100 will be one and some fractional parts; and so on for any number whatever.

And since the integral part of a logarithm is always thus readily found, it is usually called the index, or characteristic; and is commonly omitted in the tables; being left to be supplied by the operator himself, as occasion requires.

To find the logarithm of any of the natural numbers, 1, 2, 3, 4, &c. according to the method of Napier.—Take the geometrical series, 1, 10, 100, 1000, 10,000, &c. and apply it to the arithmetical series, 1, 2, 3, 4, as logarithms. 2. Find a geometric mean between 1 and 10, 10 and 100, or any other two adjacent terms of the series betwixt which the number proposed lies. 3. Between the mean, thus found, and the nearest extreme, find another geometrical mean, in the same manner; and so on, till you have arrived within the proposed limit of the number whose logarithm is sought. 4. Find as many arithmetical means, in the same order that you found the geometrical ones, and the last of these will be the logarithm answering to the number required.

Examples. Let it be required to find the logarithm of 9.

Here the numbers between which 9 lies are 1 and 10.

First, then, the log. of 10 is 1; and the log. of 1 is 0, therefore $\frac{1+0}{2} = .5$ is the arithmetical mean, and $\sqrt{(1 \times 10)} = \sqrt{10} = 3.1622777 =$ geometric mean: whence the logarithm of 3.1622777 is .5

Secondly, the log. of 10 is 1, and the log. of 3.1622777 is .5; therefore $\frac{15}{2} = .75 =$ arithmetrical mean, and $\sqrt{}\,(10 \times 3.1622777) = 5.6231182 =$ geometric mean: whence the log. of 5.6234132 is .75.

Thirdly, the log. of 10 is 1, and the log. of 5.6234132 is .75; therefore $\frac{1+75}{2} = .875 =$ arithmetical mean, and $\sqrt{}\,(10. \times 5.6234132 = 7.4989421 =$ geometrical mean; whence the log. of 7.4989421 is .875.

Of the method of using a table of logarithms.

In taking out of a table the logarithm of any number not exceeding 10000, we have the decimal part by inspection; and if to this the proper characteristic be affixed, it will give the complete logarithm required.

But if the number, whose logarithm is required, be above 10000, then find the logarithm of the two nearest numbers to it that can be found in the table, and say, as their difference : the difference of their logarithms . . the difference of the nearest number and that whose logarithm is required : the difference of their logarithms nearly; and this difference being added to, or subtracted from, the nearest logarithm, according as it is greater or less than the required one, will give the logarithm required nearly.

Thus, let it be required to find the logarithm of 367182.

The decimal part of 3671 is by the table 5647844; and of 3672 is .5649027;

$$\therefore \text{The log. of} \left\{ \begin{matrix} 367100 \text{ is } 5.5647844 \\ 367200 \text{ is } 5.5649027 \end{matrix} \right\}$$

$$\text{Their diff. } 100 \qquad .0001183 \text{ diff.}$$

$$\begin{matrix} \text{Nearest No.} \\ \text{Given No.} \end{matrix} \left\{ \begin{matrix} 367200 \\ 367182 \end{matrix} \right\}$$

$$18 \text{ diff.}$$

Therefore 100 : .0001183 : : 18 : .0000212.

And 5.5649027 — .0000212 = 5.5648815 = logarithm of 367182, nearly.

If the number consists both of integers and fractions, or is entirely fractional, find the decimal part of the logarithm as if all its figures were integral; and this, being prefixed to the proper characteristic, will give the logarithm required.

And if the given number is a proper fraction, subtract the logarithm of the denominator from the logarithm of the numerator, and the remainder will be the logarithm sought; which being that of a decimal fraction, must always have a negative index.

And, if it is a mixed number, reduce it to an improper fraction, and find the difference of the logarithms of the numerator and denominator, in the same manner as before.

In finding the number answering to any given logarithm, the index, if affirmative, will always shew how many integral places the required number consists of; and, if negative, in what place of decimals the first, or significant figure, stands; so that, if the logarithm can be found in the table, the number answering to it will always be had by inspection.

But if the logarithm cannot be exactly found in the table, find the next greater, and the next less, and then say, As the difference of these two logarithms : the difference of the numbers answering to them : : the difference of the given logarithm, and the nearest tabular logarithm : a fourth number: which added to, or subtracted from, the natural number answering to the nearest tabular logarithm, according as that logarithm is less or greater than the given one, will give the number required nearly.

Thus, let it be required to find the natural number answering to the logarithm 5.5648815.

The next less and greater logarithms, in the table, are

$$\left. \begin{matrix} 5.5647844 \\ 5.5649027 \end{matrix} \right\} \begin{matrix} \text{The number} \\ \text{answering} \end{matrix} \left\{ \begin{matrix} 367100 \\ 367200 \end{matrix} \right.$$

$$\text{Their diff. } .0001183 \qquad\qquad 100$$

And 5,5649027 — 5.5648815 = 0000212.

Therefore .0001183 : 100 : : .0000212 : 18 nearly.

Whence 367200 — 18 = 377182 = number required.

The Use and Application of Logarithms.—It is evident, from what has been said of the construction of logarithms, that addition of logarithms, must be the same thing as multiplication in common arithmetic; and subtraction in logarithms the same as division; therefore, in multiplication by logarithms, add the logarithms of the multiplicand and multiplier together, their sum is the logarithm of the product.

		num.	logarithms.
Example.	Multiplicand	8.5	0.9294189
	Multiplier	10	1.0000000
	Product -	85	1.9294189

And in division, subtract the logarithm of the divisor from the logarithm of the dividend, the remainder is the logarithm of the quotient.

		num.	logarithms.
Example.	Dividend	9712.8	3.9873444
	Divisor	456	2.6589648
	Quotient	21.3	1.3283796

To find the Complement of a Logarithm.—Begin at the left hand, and write down what each figure wants of 9, only what the last significant figure wants of 10; so the complement of the logarithm of 456, viz. 2,6589648, is 7.3410352.

In the Rule of Three. Add the logarithms of the second and third terms together, and from the sum subtract the logarithm of the first, the remainder is the logarithm of the fourth. Or, instead of subtracting a logarithm, add its complement, and the result will be the same.

To raise Powers by Logarithms.—Multiply the logarithm of the number given, by the index of the power required, the product will be the logarithm of the power sought.

Example. Let the cube of 32 be required by logarithms. The logarithm of 32 = 1.5051500, which multiplied by 3, is 4.5154500, the logarithm of 32768, the cube of 32. But in raising powers, viz. squaring, cubing, &c. of any decimal fraction by logarithms, it must be observed, that the first significant figure of the power be put so many places below the place of units, as the index of its logarithm wants of 10, 100, &c. multiplied by the index of the power.

To extract the Roots of Powers by Logarithms.—Divide the logarithm of the number by the index of the power, the quotient is the logarithm of the root sought.

To find Mean Proportionals between any two numbers.—Subtract the logarithm of the least term from the logarithm of the greatest, and divide the remainder by a number more by one than the number of means desired; then add the quotient to the logarithm of the least term (or subtract it from the logarithm of the greatest) continually, and it will give the logarithms of all the mean proportionals required.

Example. Let three mean proportionals be sought, between 106 and 100.

Logarithm of 106=2.0253059
Logarithm of 100=2.0000000

Divide by 4)0.0253059 (0.0063264.75

Log. of the least term	100 added	2.0000000
Log. of the 1st mean	101.4673846	2.0063264.75
Log. of the 2d mean	102.9563014	2.0126529.5
Log. of the 3d mean	104.4670483	2.0189794.25
Log. of the greatest term	106,	2.0253059

It may be of service to the reader here to observe, that one of the most valuable works on this subject, and which is justly held in high repute, as well for its accuracy as for the extent of information it contains, is Dr. Hutton's Mathematical Tables.

LOGIC. Logic is the science which professes to teach the proper application of the mental faculties in all deductions of reasoning. Those, therefore, who have treated expressly of this subject, have endeavoured first, to define and describe the several faculties and operations of the human mind, as perception, judgment, memory, invention, &c. They next proceed to lay down rules for correct reasoning and argument. Every act of the judgment they term a *proposition*, and all propositions are either affirmative or negative. All questions or arguments they reduce to syllogisms, that is from two axioms or propositions (called *terms*, in the technical language) laid down, they reduce a third or conclusion, and the previous propositions they divide into major and minor. Thus, let the question be, *Whether God is an intelligent being?* Here the major or principal proposition proceeds from the word intelligent, and the minor respects God. They would then arrange the syllogism as follows:

Maj. To dispose things in right and perfect order, is the work of an intelligent Being:

Min. But God has disposed creation in right and perfect order;

Conclusion. Therefore, God is an intelligent Being.

They next class or arrange the different kinds of syllogisms according to the nature of them. Propositions are not only affirmative and negative, but they are also particular or universal. Hence syllogisms will vary not only as the major or minor proposition is negative or affirmative, but as either is a universal or particular affirmative, &c.

Mood and figure are words applied by logical writers to denote the arrangement of the terms of a syllogism. It is done by the use of the letters A, E, I, O, of which A denotes universal affirmative; E, universal negative; I, particular affirmative; and O, particular negative. But as it would be difficult to retain in the memory the various changes in the order of these letters, if prefixed to the three parts of a syllogism, fourteen artificial words have been formed, of three syllables each, containing the vowels so to be prefixed in the order of the mood to be denoted by each word. The fourteen moods are classed under these different figures, by which terms logicians mean to denote the particular situation of the middle term, with respect to the major and minor. The first figure is distinguished by the middle term being the subject of the major, and predicate of the minor proposition, and its four moods are denoted by the words *Barbara*, *Celarent*, *Darii*, *Ferio*. The second figure admits of negative conclusions only, the major being always universal, and one of the premises negative. Its moods are *Cesare*, *Camestres*, *Festino*, *Baroco*. And in the third figure the middle term is the subject of both premises, the minor affirmative, and the conclusion, particular. Its moods are *Darapti*, *Felapton*, *Disamis*, *Datisi*, *Bocardo*, *Ferison*.

The following are some of the terms in most common use in logic.

Method is analytical or synthetical. *Analytical method* resolves the compound into its principles, and the whole into its parts. *Synthetical method* begins with the parts, and leads to a whole, or it puts together the principles and forms a compound.

Argumentum at judicium, an appeal to the common sense of mankind;—*ad fidem*, to their faith;—*ad hominem*, to the practices or professed principles of the adversary;—*ad populum*, an appeal to the people;—*ex concesso*, when something is proved by means of some proposition previously conceded;—*ad passiones*, an appeal to the passions.

Certainty or Truth is of several kinds; there is a *mathematical certainty*, which admits of demonstration; a *moral certainty*, which is derived from testimony; a *physical certainty*, derived from the evidence of the senses and the course of nature; and a *theological certainty*, founded on the doctrine of the Scriptures.

Evidence is of different kinds; as the *evidence of sense*, founded on the perceptions of our senses; *the evidence of intuition*, on self-evident axioms, as, that the whole is greater than a part, or, every effect is produced by some cause; *the evidence of reason*, founded on clear and indubitable deductions from well-founded premises and doctrines; and *the evidence of faith*, deduced from the testimony of others.

Demonstrations;—*à priori*, is, when the effect is proved by referring to the cause;—*à posteriori*, is when the cause is inferred from the effects.

Sophistry is reasoning founded on false premises, or an ambiguity of terms. *A Sophism of composition* is when we infer that of any thing in an aggregate or compounded sense, which is only true in a divided sense. *A Sophism of division* is when we infer any thing in a divided sense which is only true in a compounded sense. *A Sophism of equivocation* is when we use words of an ambiguous or double

sense, and draw inferences in one sense, of which the proposition is capable only in the other.

Petitio principii, or begging the question, is the supposition of what is not granted, or a supposed proof, by stating the question in other words. *The Reductio ad absurdum* is when the truth of a proposition is proved by showing the absurdity of a contrary supposition.

A false induction is when general deductions are made from a limited number of experiments or facts. *The fallacia accidentis* is when we draw inferences in regard to the nature of a thing, from circumstances only temporary or accidental. *The Ignorantia elenchi* is a mistake of the question, or when one thing is proved instead of another.

LOGISTICA *numeralis*, the same with algorithm. See ALGORITHM.

LOGISTICAL *arithmetic*, the doctrine of sexagesimal fractions. See SEXAGESIMALS.

LOGOGRAPHY, a method of printing, in which the types, instead of answering only to a single letter, are made to correspond to whole words. The properties of the logographic art are, 1. That the compositor shall have less charged upon his memory, than in the common way. 2. It is much less liable to error. 3. The type of each word is as easily laid hold of as that of a single letter. 4. The decomposition is much more readily performed. 5. No extraordinary expense, nor greater number of types, is required in the logographic, than in the common method of printing.

LOGWOOD, an article well known in the arts, but chiefly used by dyers. The tree which produces it is called by Linnæus, hæmatoxylum Campechianum.

Logwood is so heavy as to sink in water, hard, compact of a fine grain, capable of being polished, and scarcely susceptible of decay. predominant colour is red, tinged with orange, yellow, and black. It yields its colour both to spirituous and watery menstrua. Alcohol extracts it more readily and copiously than water. The colour of its dye is a fine red, inclining a little to violet or purple, which is principally observable in its watery decoction. This, left to itself, becomes in time yellowish, and at length black. Acids turn it yellow; alkalis deepen its colour, and give it a purple or violet hue. See DYEING.

LOLIUM, in botany, *ray grass*, a genus of the triandria digynia class and order, natural order of gramineæ, or grasses. Essential character: calyx one-leafed, fixed, many-flowered. There are five species.

LOMENTACEÆ, in botany, the name of the thirty-third order in Linnæus's Fragments of a natural method, consisting of plants, many of which furnish beautiful dyes, and the pericarpium of which, universally a leguminous pod, contains seeds that are farinaceous or meally like those of the bean. The cassia, wild senna; hæmatoxylon, logwood; mimosa, sensitive plant, &c. are of this order.

LONCHITIS, *spleenwort* a genus of the cryptogamia filices class of plants, the fructifications of which are arranged into lunulated series, and disposed separately under the sinuses of the leaves. There are five species. The leaves of this plant are of use in healing wounds, and in preventing inflammations of them: they are also used against the spleen. The root is aperient and diuretic.

LONGEVITY, may be defined—the continuance of life beyond the ordinary period of duration. The desire of self-preservation is one of the first principles of our nature, and has been implanted in us for the wisest purposes.

While it excites to labour and exertion in procuring the means of supporting our mortal existence, it reconciles us to bear with patience, many distresses and pains, which are in some measure the lot of all. It would be a difficult task to attempt to form a particular set of directions which would be applicable to the various constitutions and employments of mankind. But there are general rules, which all may follow with safety and advantage; and the advice of the celebrated Galen will be found adapted to every situation in which man can be placed.

"Consult your reason," says he, "and observe what agrees and what does not agree with you, that, like wise men, you may adhere to the use of such things as conduce to your health, and forbear every thing which, by your own experience, you find to do you hurt; and be assured, that by a diligent observation and practice of this rule, you may enjoy a good share of health, and seldom stand in need of physic or physicians."

LONGIMETRY, the art of measuring lengths, both accessible, as roads, &c. and inaccessible, as arms of the sea, &c. See SURVEYING.

LONGITUDE *of a star*, in astronomy, an arch of the ecliptic, intercepted between the beginning of Aries and the point of the ecliptic cut by the star's circle of longitude. See CIRCLE, &c.

LONGITUDE *of a place*, in geography, is an arch of the equator intercepted between the first meridian, and the meridian passing through the proposed place; which is always equal to the angle at the pole, formed by the first meridian and the meridian of the place.

LONGITUDE, in navigation, the distance of a ship or place, east or west, from another, reckoned in degrees of the equator.

To find the longitude by a Time-Keeper. The sun appears to move round the earth from east to west, or to describe 360°, in 24 hours, and therefore he appears to move 15° in an hour. If therefore the meridians of two places make an angle of 15° with each other, or if the two places differ 15° in longitude, the sun will come to the eastern meridian one hour before he comes to the western meridian, and therefore when it is twelve o'clock at the former place, it is only eleven at the latter; and in general, the difference between the times by the clock at any two places, will be the difference of their longitudes, converted into time at the rate of 15° for an hour, the time at the eastern place being the forwardest. If, therefore, we can tell what o'clock it is at any two places at the same instant of time, we can find the difference of their longitudes, by allowing 15° for every hour that the clocks differ.

Let, therefore, the timekeeper be well regulated and set to the time at Greenwich, that being the place from which we reckon our longitude; then if the watch neither gains nor loses, it will always show the time at Greenwich, wherever you may be.

LONGITUDINAL, in general, denotes something placed lengthwise: thus some of the fibres of the vessels in the human body are placed longitudinally, others transversely, or across.

LONICERA, *honeysuckle*, a genus of the monogynia order, in the pentandria class of plants. The corolla is monopetalous and irregular; the berry polyspermous, bilocular, and inferior. There are 19 species, of which the most remarkable are, L. grata, ever-green honey-suckle, is the most beautiful: it grows naturally in North America: it has strong branches, covered with a purple bark, which are ornamented with lucid green leaves, embracing the stalks, and continuing their verdure all the year; the flowers are produced in whorled bunches at the end of the branches; there are frequently two, and sometimes three, of these bunches rising one out of the other; they are of a bright red on their outside, and yellow within, of a strong aromatic flavour; it begins to flower in June, and there is a constant succession of flowers till the frost puts an end to them.

LOOF, in the sea-language, is a term used in various senses; thus the loof of a ship is that part of her aloft which lies just before the chest-tree; hence the guns which lie there are called loof-pieces: keep your loof, signifies, keep the ship near to the wind; to loof into a harbour, is to sail into it close by the wind; loof up, is to keep nearer the wind; to spring the loof, is when a ship that was going large before the wind, is brought close by the wind.

LOOKING-GLASSES, are nothing but plane mirrors of glass; which being impervious to the light, reflect the images of things placed before them.

LOOM, a frame composed of a variety of parts, used in all the branches of weaving; for a particular description of which see WEAVING.

LOOM, in the sea-language: when a ship appears big, when seen at a distance, they say she looms.

LOOP, in the iron works, denotes a part of a sow, or block of cast iron, broken or melted off from the rest.

LOOP *holes*, in a ship, are holes made in the coamings of the hatches of a ship, and in their bulk-heads, to fire muskets through, in a close fight.

LOPHIUS, *fishing-frog*, *toad-fish*, or *sea-devil*, a genus of the branchiostegious order of fishes, whose head is in size equal to all the rest of the body. There are three species, the most remarkable of which is the piscatorius, or common fishing-frog, an inhabitant of the British seas. This singular fish grows to a large size, some being between four and five feet in length; and Mr. Pennant mentions one taken near Scarborough, whose mouth was a yard wide. The fishermen on that coast have a great regard for this fish, from a supposition that it is a great enemy to the dog-fish; and whenever they take it with their lines, set it at liberty.

LORD. See PEER.

LORD'S DAY. All persons not having a reasonable excuse, shall resort to their parish church or chapel (or some congregation of religious worship allowed by the toleration act) on every Sunday, on pain of punishment by the censures of the church, and of forfeiting 1s to the poor for every offence; to be levied by the churchwardens by distress, by warrant of one justice. The hundred shall not be answerable for any robbery committed on the Lord's day. No carrier shall travel, or drover drive cattle on the Lord's day, under the penalty of 20*l*. No person upon the Lord's day shall serve or execute any writ, process, warrant, order, judgment, or decree (except in cases of treason, felony, or breach of the peace), but the service thereof shall be void. These, like many other laws in the English code, are now entirely disused, or only enforced on a solitary individual now and then, to gratify personal malice.

LOTTERY, a game of hazard, in which small sums are adventured for the chance of obtaining a larger value, either in money or other articles. Lotteries are formed on various plans; but in general they consist of a certain number of tickets, which are drawn at the same time, with a corresponding number of blanks and prizes mixed together, and by which the fate of the tickets is determined.

This species of gaming has been sanctioned by the governments of France, Holland, Great Britain, and other countries, as a means of raising money for public purposes; as from the contributions being voluntary, it is always easier to obtain money in this way than by new taxes; it is, however liable to the serious objection, that it tempts many persons to lose more than they can conveniently spare, particularly among the lower classes of society, who are led to neglect the gains of honest industry for the chance of acquiring sudden riches by a prize in the lottery.

LOUIS, or KNIGHTS OF ST. LOUIS, the name of a military order in France, instituted by Louis XIV. in 1693.

LOUSE. See PEDICULUS.

LOXIA, a genus of birds of the order of passeres, the distinguishing characters of which are: the bill is strong, convex above and below, and very thick at the base; the nostrils are small and round; the tongue is as if cut off at the end; the toes are four, placed three before and one behind, excepting one species, which has only two toes before and one behind. The most remarkable are:

1. The *curvirostra*, or common cross-bill, is about the size of a lark, is known by the singularity of its bill, both mandibles of which curve opposite ways and cross each other: the general colour of the plumage in the male is of a red-lead, inclining to rose-colour; the wings and tail are brown; the legs black. The female is of a green colour, mixed with brown in those parts where the male is red. It is found in North America and Greenland; and is said to make its nest in the highest parts of the fir trees, fastening it to the branch with the resinous matter which exudes from the trees.

2. The *coccothraustes*, or haw-finch, is in length seven inches. This species is ranked among the British birds; but only visits these kingdoms occasionally, and for the most part in winter, and is never known to breed here. It is more plentiful in France. It feeds on berries, kernels, &c.

3. The *pyrrhula*, or bullfinch, is so generally known as almost to supersede description. This species is common in most parts of the continent of Europe, and throughout Russia and Siberia,

at which last places it is caught for the table. In winter it approaches gardens and orchards, and has been generally stigmatised for making havock among the buds of trees. The bullfinch in its wild state, has only a plain note; but when tamed, it becomes remarkably docile, and may be taught any tune after a pipe, or to whistle any notes in the best manner: it seldom forgets what it has learned; and will become so tame as to come at call, perch on its master's shoulders, and (at command) go through a difficult musical lesson. They may be also taught to speak, and some thus instructed are annually brought to London from Germany.

4. The *cardinalis*, or cardinal grossbeak, is near eight inches in length. The bill is stout, and of a pale-red colour; the irides are hazel; the head is greatly crested, the feathers rising up to a point when erect; round the bill, and on the throat, the colour is black: the rest of the bird of a fire-red. This species is met with in several parts of North America, and has attained the name of Virginia nightingale, from the fineness of its song, the note of which resembles that of the nightingale.

5. The *orix*, or grenadier grossbeak, is about the size of a house-sparrow. The forehead, sides of the head, and chin are black; the breast and belly the same; the wings are brown, with pale edges; and the rest of the body of a beautiful red colour. These birds are inhabitants of St. Helena; they are also in plenty at the Cape of Good Hope, where they frequent watery places that abound with reeds, and among which they are supposed to make their nest.

LOZENGE, **Lozange**, *rhombus*, in geometry, a quadrilateral figure, consisting of four equal and parallel sides, two of whose opposite angles are acute and the other two obtuse; the distance between the two obtuse ones being always equal to the length of one side.

Lozenge, in pharmacy, the same with what is otherwise called troche.

LUCANUS, *stag-chaffer*, a genus of insects of the order coleoptera; the generic character is, antennæ clavated, with compressed tip, divided into lamellæ on the inner side; jaws stretched forwards, exserted, and toothed. The principal species is the lucanus cervus, commonly known by the name of the stag-beetle, or stag-chafier. It is the largest of all the European coleopterous insects, sometimes measuring nearly two inches and a half in length, from the tips of the jaws to the end of the body. Its general colour is a deep chesnut, with the thorax and head, which is of a squarish form, of a blacker cast: and the jaws are often of a brighter or redder chesnut colour than the wing-shells; the legs and under parts are coal-black, and the wings, which, except during flight, are concealed under the shells, are large and of a fine pale yellowish brown. This remarkable insect is chiefly found in the neighbourhood of oak-trees, delighting in the sweet exsudation or honey-dew so frequently observed on the leaves.

LUCERNE, is a plant frequently cultivated in the manner of clover. Its leaves, like the latter, grow three at a joint, its stalks are erect, and after mowing, immediately spring up again from the stubble. It is made into hay, in the same manner as saintfoin, but should be mowed before it flowers. It makes the sweetest and most fattening food in the world for cattle.

LUCIDA, in astronomy, an appellation given to several fixed stars on account of their very superior brightness; as the lucida coronæ, a star of the second magnitude in the northern crown.

LUDWIGIA, a genus of the monogynia order, in the tetrandria class of plants, and in the natural method ranking under the 17th order, calycanthemæ. There are four species, annuals of the West Indies.

LUES, among physicians is, in general, used for a disease of any kind; but in a more particular sense, is restrained to contagious and pestilential diseases, as the lues venerea.

LUMBAGO, in medicine, a rheumatic affection of the muscles about the loins.

LUNA, in astronomy, the moon. See Moon.

LUNAR, something belonging to the moon: thus we say lunar month, lunar year, lunar dial, lunar eclipse, &c.

Lunar *caustic*, is the old name for nitrate of silver, a very powerful caustic, much used in medicine. It is also called "lapis infernalis," by surgeons.

LUNATIC. See Idiot.

LUNATION, the period or time between one new moon and another: it is also called the synodical month, consisting of 29d. 12h. 44′ 3″ 11-3ds; exceeding the periodical month by 2d. 5h. 0′ 55.″

LUNE, in mathematics, is a geometrical figure, in form of a crescent, terminated by the arcs of two circles that intersect each other within.

LUNGS. See Anatomy, and Physiology.

LUPINUS, *lupin*, a genus of the decandria order, in the diadelphia class of plants, and in the natural method ranking under the 32d order, papilionaceæ. There are ten species, chiefly hardy herbaceous flowery annuals, rising with upright stalks from one to three or four feet high, ornamented with digitate or fingered leaves, and terminated by long whorled spikes of papilionaceous flowers, white, blue, yellow, and rose-coloured.

LUPUS, in astronomy, a southern constellation, consisting of 19, or, according to Flamsteed, of 24 stars.

LUST, in the sea-language. When a ship heels more one way than another, she is said to have a lust that way

LUSTRE, in mineralogy, is a term much used in modern works of chemistry. The lustre of minerals in respect of intensity, is of five kinds; 1. Splendent, when in full day-light the lustre can be seen at a great distance. 2. Shining, when at a distance the reflected light is weak: 3. Glistening, when the lustre is only observable at no greater distance than an arm's length. 4. Glimmering, when the surface held near the eye in full day-light presents a number of shining points: 5 Dull, when the surface

has no lustre. There are two kinds of lustre, the metallic and common. See THOMPSON'S CHEMISTRY.

LUTE, a stringed instrument formerly much in use; anciently containing only five rows of strings, but to which six, or more, were afterwards added. The lute consists of four parts, viz. the table, the body which has nine or ten sides; the neck, which has as many stops or divisions; and the head, or cross, in which screws for turning it are inserted. In playing this instrument, the performer strikes the strings with the fingers of the right hand, and regulates the sounds with those of the left hand.

LUTE. The lutes with which the joinings of vessels are closed, are of different kinds, according to the nature of the operations to be made, and of the substances to be distilled in these vessels. When vapours of watery liquors, and such as are not corrosive, are to be contained, it is sufficient to surround the joining of the receiver to the nose of the alembic, or of the retort, with slips of paper or of linen, covered with flour-paste. In such cases also slips of wet bladder are very conveniently used.

When more penetrating and dissolving vapours are to be contained, a lute is to be employed of quicklime slacked in the air, and beaten into a liquid paste with whites of eggs. This paste is to be spread upon linen slips, which are to be applied exactly to the joining of the vessels. This lute is very convenient, easily dries, becomes solid, and sufficiently firm. Of this lute, vessels may be formed hard enough to bear polishing on the wheel. Lastly, when acid and corrosive vapours are to be contained, we must then have recourse to the lute called *fat lute*. This lute is made by forming into a paste some dried clay finely powdered, sifted through a silken searce, and moistened with water, and then by beating this paste well in a mortar with boiled linseed oil, that is, oil which has been rendered drying by litharge dissolved in it, and fit for the use of painters. This lute easily takes and retains the form given to it. It is generally rolled into cylinders of a convenient size. These are to be applied, by flattening them to the joinings of the vessels, which ought to be perfectly dry, because the least moisture would prevent the lute from adhering. When the joinings are well closed with this fat lute, the whole is to be covered with slips of linen spread with lute of lime, and whites of eggs. These slips are to be fastened with packthread. The second lute is necessary to keep on the flat lute, because this latter remains soft, and does not become solid enough to stick on alone. Fine porcelain clay, mixed with a solution of borax, is well adapted to iron vessels, the part received into an aperture being smeared with it.

LYCOPODIUM. The fine dust of lycopodium, or clubmoss, is properly the seeds of the plant, and when diffused or strewed in the air, it takes fire from a candle, and burns off like a flash of lightning. It is used in the London theatres.

LYDIAN *stone*, in mineralogy, is of a greyish black colour, which passes into velvet black; it occurs massive, and is likewise found in trapezoidal-shaped rolled pieces, with rounded angles; it is hard, but not very heavy. This mineral is found near Prague and Carlsbad, in Bohemia; in other parts of Germany, and in Scotland. When polished it is used as a test stone for determining the purity of gold and silver; owing, however, to its great hardness, it is less suited for this purpose than basalt. It takes its name from the circumstance of its being first found in the province of Lydia, in Lesser Asia.

LYING *to*, in naval affairs, the situation of a ship when she is retarded in her course, by arranging the sails in such a manner as to counteract each other with nearly equal effort, and render the ship almost stationary with respect to her head-way; a ship is usually brought to by laying down her main-top-sail aback the helm being put close down to leeward. This is particularly practised in a general engagement, when the hostile fleets are drawn up in two lines of battle opposite each other.

LYMPH. See ANATOMY, and PHYSIOLOGY.

LYNX. See FELIS.

LYRE, *lyra*, in astronomy, a constellation of the northern hemisphere, the number of whose stars, in Ptolemy and Tycho's catalogues, are only ten, but nineteen in the Britannic catalogue.

LYRE *lyra*, a musical instrument of the string kind, much used by the ancients.

LYRIC. See POETRY.

LYSIMACHIA, *loosestrife*, a genus of the monogynia order, in the pentandria class of plants, and in the natural method ranking under the 20th order, rotaceæ. There are 12 species, but only four are commonly cultivated in gardens. These are hardy herbaceous perennials and biennials, rising with erect stalks from 18 inches to two or three feet high, and terminated by spikes and clusters of monopetalous, rotated, five-parted spreading flowers of white and yellow colours.

LYTHRUM, *purple loosestrife*, a genus of the monogynia order, in the decandria class of plants, and in the natural method ranking under the 17th order, calycanthemæ. There are 18 species, of which the most remarkable is, the cilicari, or common purple loosestrife, with oblong leaves, is a native of Britain, and grows naturally by the sides of ditches and rivers.

M.

M, the twelfth letter of our alphabet. As a numeral it stands for mille a thousand; and with a dash over it, thus M, for a thousand times a thousand, or 1,000,000. M. A. magister artium; MS. manuscript, and MSS. manuscripts. In the prescriptions of physicians, M. stands for manipulus, a handful; and sometimes for misce, or mixtura.

MABA, a genus of the triandria order, in the diœcia class of plants. There is one species, a tree of the Friendly Islands.

MABEA, a genus of the monoecia polyandria class and order. The calyx is one-leaved; corolla none. There are two species, called pipewood, shrubs of the West Indies.

MACARONIC, or *macaronian*, an appellation given to a burlesque kind of poetry, made up of a jumble of words of different languages, and words of the vulgar tongue latinized. The Italians are said to have been the inventors of it. The Germans, French, Spaniards, &c. have also had their macaronic poets; nor is Great Britain outdone in this respect, as appears from a poem by Drummond of Hawthornden, called Polemo Middinia, and which begins thus,

> Nymphæ, quæ colitis bighissima monta Fifæa,
> Seu vos Pittenweema tenet, seu Crelia crofta,
> &c.

MACE, the second coat of the kernel of the nutmeg, is a thin and membranaceous substance, of an oleaginous nature, and a yellowish colour, being met with in flakes of an inch or more in length, which are divided into a multitude of ramifications. It is of an extremely fragrant, aromatic and agreeable flavour, and of a pleasant, but acrid and oleaginous taste. See MYRISTICA

MACERATION, in pharmacy, is an infusion of, or soaking ingredients in, water or any other fluid, in order either to soften them, or draw out their virtues.

MACHINE. See MECHANICS.

MACHINERY, in epic and dramatic poetry, is when the poet introduces the use of machines, or brings some supernatural being upon the stage, in order to solve some difficulty, or to perform some exploit out of the reach of human power. The ancient dramatic poets never made use of machines, unless where there was an absolute necessity for so doing; whence the precept of Horace,

> "Nec Deus intersit, nisi dignus vindice
> nodus—inciderit."

MACKREL. See SCOMBER.

MACROCNEMON, a genus of the class and order pentandria monogynia. The cor. is bell-shaped; the capsule two-celled, two-valved; seeds imbricate. There are three species, small trees of the West Indies.

MACROPUS, the *kanguroo*, in natural history, a genus of mammalia of the order Feræ. Generic character: six front teeth in the upper jaw, emarginated; two in the lower, and very long, sharp, large, and pointing forwards; five grinders on each side of the upper and under jaw, distant from the other teeth; fore-legs very short; hind ones very long; the female with an abdominal pouch. This is one of the most curious of all the animals discovered on the continent of New South Wales, where it was observed by some of the sailors of Captain Cook in the year 1770. When full grown it weighs about 150 pounds. Its head somewhat resembles that of a deer, but is destitute of horns; its colour is of a pale brown; its length from the nose to the tail is between four and five feet, and the length of the tail is about three feet. Its general position, when resting, is that of standing on its hind feet, on their whole extent to the knees, and its fore-feet are frequently employed, like those of the squirrel, as hands. They are often, however, laid on the ground, and the kanguroo is often seen in this posture, feeding. Vegetables, and particularly grass, constitute its only nourishment. In its rapid motions, however, the fore-feet are wholly useless, and it proceeds by leaping on its hind feet, which it will do to the distance of fourteen or sixteen feet, and with bounds so rapid in succession, that it exceeds in swiftness a common dog. Kanguroos possess the faculty of separating at pleasure the two front teeth of their lower jaw; and the female is furnished with a pouch in the abdomen, of extraordinary depth, in which are placed two teats. But one young one is produced at a time, which, when first observed in the pouch, after its birth, is scarcely more than an inch in length, but grows to a considerable size in this natural receptacle before it quits it, and frequently recurs to it for warmth and security after its first dislodgment from it. This animal is in this striking circumstance allied to the opossum genus, under which Gmelin ranks it; but it differs from the opossum materially in respect to the structure of the teeth.

MACULÆ, in astronomy, are dark spots appearing on the luminous surfaces of the sun and moon, and even some of the planets. The solar maculæ are dark spots of an irregular and changeable figure, observed in the face of the sun. These were first observed in November and December of the year 1610, by Galileo in Italy, and Harriot in England, unknown to, and independent of, each other, soon after they had made or procured telescopes.

There have been various observations made of the phenomena of the solar maculæ, and hypothesis invented for explaining them.

Many of these maculæ appear to consist of heterogenous parts; the darker and denser being called, by Hevelius, nuclei, which are encompassed, as it were, with atmospheres, somewhat rarer and less obscure; but the figure, both of the nuclei and entire maculæ, is variable. These maculæ are often subject to sudden mutations.

The spots, or maculæ, observable on the moon's surface, seem to be only cavities or large caverns, on which the sun shining very obliquely, and touching only their upper edge with his light, the deeper places remain without light; but as the sun rises higher upon them

they receive more light, and the shadow, or dark parts, grow smaller and shorter, till the sun comes at last to shine directly upon them, and then the whole cavity will be illuminated: but the dark dusky spots, which continue always the same, are supposed to proceed from a kind of matter or soil which reflects less light than that of the other regions.

MADDER, a substance very extensively employed in dyeing, is the root of the rubia tinctorum. Although madder will grow both in a stiff clayey soil and in sand, it succeeds better in a moderately rich, soft, and somewhat sandy soil: it is cultivated in many of the provinces of France, in Alsace, Normandy, and Provence: the best of European growth is that which comes from Zealand. The best roots are about the thickness of a goose quill, or at most of the little finger; they are semitransparent, and of a reddish colour: they have a strong smell, and the bark is smooth. Hellot ascribes the superiority of the madder which comes from the Levant to the circumstance of its having been dried in the open air. The red colouring matter of madder may be dissolved in alcohol, and on evaporation a residium of a deep red is left. Fixed alkali forms in this solution a violet, the sulphuric acid a fawn coloured, and the sulphate of potash, a fine red precipitate. Precipitate of various shades may be obtained by alum, nitre, chalk, sugar of lead, and the muriate of tin. The quantity of aqueous chlorine required to destroy the colour of a decoction of madder, is double what is necessary to destroy that of a decoction of an equal weight of Brasil wood.

Wool would receive from madder only a perishable dye, if the colouring particles were not fixed by a base, which occasions them to combine with the stuff more intimately, and which in some measure defends them from the destructive influence of the air. For this purpose, the woollen stuffs are first boiled for two or three hours with alum and tartar, after which they are left to drain; they are then slightly wrung and put into a linen bag, and carried into a cool place, where they are suffered to remain for some days.

The madder red of cotton is distinguished into two kinds: one is called simple madder red; the other, which is much brighter, is called Turkey or Adrianople red, because it comes from the Levant, and has seldom been equalled in brightness or durability by our artists. Galls or sumach dispose thread and cotton to receive the madder colour, and the proper mordant is acetate of alumina. The nitrate and muriate of iron as a mordant produces a better effect than the sulphate and acetate of the same metal; they afford a beautiful, well saturated violet colour.

MADREPORA, in natural history, the name of a genus of submarine substances, the characters of which are, that they are almost of a stony hardness, resembling the corals, and are usually divided into branches, and pervious by many holes or cavities, which are frequently of a stellar figure. In the Linnæan system, this is a genus of lithophyta; the animal that inhabits it is a medusa; it comprehends about 120 species.

MADREPORITE, a mineral found in the valley of Russback, in Salzburg, and so called from its external resemblance to madrepore. It is found in large masses, is brittle and moderately heavy. Its component parts are,

Carbonate of lime	93.00
Carbonate of magnesia	0.50
Carbonate of iron	2.25
Charcoal	0.50
Silica	4.50
	99,75
Loss	25
	100

MADRIER, in the military art, a long and broad plank of wood, used for supporting the earth in mining and carrying on a sap, and in making coffers, caponiers, galleries, and for many other uses at a siege.

MADRIGAL, in the Italian, Spanish, and French poetry, is a short amorous poem, composed of a number of free and unequal verses, neither confined to the regularity of a sonnet, nor to the point of an epigram, but only consisting of some tender or delicate thought, expressed with a beautiful, noble, and elegant simplicity.

MAGAZINE, a place in which stores are kept, or arms, ammunition, provisions, &c. Every fortified town ought to be furnished with a large magazine, which should contain stores of all kinds, sufficient to enable the garrison and inhabitants to hold out a long siege.

Magazine, *powder*, is that place where the powder is kept in very large quantities. Authors differ greatly both in regard to situation and construction; but all agree, that they ought to be arched, and bomb-proof.

MAGI, or Magians, an ancient religious sect in Persia, and other Eastern countries, who maintained, that there were two principles, the one the cause of all good, the other the cause of all evil; and abominating the adoration of images, worshipped God only by fire, which they looked upon as the brightest and most glorious symbol of Oromasdes, or the good God: as darkness is the truest symbol of Arimanius, or the evil God. This religion was reformed by Zoroaster. The sect still subsists in Persia, under the denomination of gaurs.

MAGIC, originally signified only the knowledge of the more sublime parts of philosophy; but as the magi likewise professed astrology, divination, and sorcery, the term magi became odious, being used to signify an unlawful diabolical kind of science, acquired by the assistance of the devil and departed souls.

Natural magic is only the application of natural philosophy to the production of surprising but yet natural effects. The common natural magic, found in books, gives us merely some childish and superstitious traditions of the sympathies and antipathies of things, or of their occult and peculiar properties; which are usually intermixed with many trifling experiments, admired rather for their disguise than for themselves.

MAGIC *lantern*. See Optics.

Magic *square*, in arithmetic, a square figure made up of numbers, so disposed in parallel and equal ranks, that the sums of each row, taken either perpendicularly, horizontally, or diagonally, are equal.

The following diagram represents one of these squares; but the subject is not deserving of any serious attention.

16	14	8	2	25
3	22	20	11	9
15	6	4	23	17
24	18	12	10	1
7	5	21	19	13

MAGNA *Charta*, the great charter of liberties, granted in 1215, the 16th year of king John, and confirmed by Edward I. The reason of its being termed *magna*, or *great*, is, either because of the excellency of the laws and liberties therein contained; or because there was another charter, called *charta de foresta*, established with it, which was the less of the two; or because it contained more than other charters; or on account of the wars and troubles in the obtaining it, or of the great and remarkable solemnity in the denouncing excommunications against the infringers of it. Magna Charta may be said to derive its origin from king Edward the Confessor, who granted several liberties and privileges, both civil and ecclesiastical, by charter; the same, with some others, were also granted and confirmed by king Henry I, by a celebrated great charter, now lost. And his successors, king Stephen, king Henry II, and finally, king John, confirmed or re-enacted the same; but this last prince violating his charter, the barons took up arms, and his reign ended in blood.—Henry III, who succeeded him, after having procured an inquisition to be made by twelve men in each county, what the liberties of England were in the time of Henry I, renewed the great charter granted by John, which he several times confirmed, and as often broke again; till in the 37th year of his reign he came to Westminster-hall, where, in the presence of the nobility and bishops, with lighted candles in their hands, Magna Charta was read, the king all the while laying his hand on his breast, and at last solemnly swearing, faithfully and inviolably to observe all things therein contained, as a man, a Christian, a soldier, and a king. Then the bishops extinguished their candles, throwing them on the ground, crying, 'Thus let him be extinguished and stink in Hell, who violates this charter.' Magna Charta was thought to be so beneficial to the subject, and a law of so great equity in comparison with those which were formerly in use, that king Henry, for restoring it, had the fifteenth penny of all the moveable goods, both temporal and spiritual. Sir Edward Coke observes, Magna Charta has been above thirty times confirmed.

MAGNESIA. One of the primitive earths, having a metallic basis, called magnesium. It has been found native in the state of hydrate.

Magnesia may be obtained, by pouring into a solution of its sulphate, a solution of subcarbonate of soda, washing the precipitate, drying it, and exposing it to a red heat. It is usually procured in commerce, by acting on magnesian limestone with the impure muriate of magnesia, or bittern of the sea-salt manufactories. The muriatic acid goes to the lime, forming a soluble salt, and leaves behind the magnesia of both the bittern and limestone. Or the bittern is decomposed by a crude subcarbonate of ammonia, obtained from the distillation of bones in iron cylinders. Muriate of ammonia and subcarbonate of magnesia result. The former is evaporated to dryness, mixed with chalk and sublimed. Subcarbonate of ammonia is thus recovered, with which a new quantity of bittern may be decomposed; and thus in ceaseless repetition, forming an elegant and economical process:—100 parts of crystallized Epsom salt, require for complete decomposition 56 of subcarbonate of potash, or 44 dry subcarbonate of soda, and yield 16 of pure magnesia after calcination.

Magnesia is a white, soft powder. Its specific gravity is 2.3 by Kirwan. It renders the syrup of violets, and infusion of red cabbage, green, and reddens turmeric. It is infusible, except by the hydroxygen blowpipe. It has scarcely any taste, and no smell. It is nearly insoluble in water; but it absorbs a quantity of that liquid with the production of heat. And when it is thrown down from the sulphate by a caustic alkali, it is combined with water constituting a hydrate, which, however, separates at a red heat. It contains about one-fourth its weight of water.

When magnesia is exposed to the air, it very slowly attracts carbonic acid. It combines with sulphur, forming a sulphuret.

Magnesia is chiefly used as an antacid, purgative, and lithontriptic in medicine. When incautiously used for a long time, it may produce very serious evils.

MAGNESIA *hydrate of*. This mineral was found by Dr. Bruce of New York, in small veins in serpentine at Hoboken, in New Jersey. Colour white. Massive. Lustre pearly. Fracture foliated or radiated. Semitransparent in the mass; transparent in single folia. Soft, and somewhat elastic. Adheres slightly to the tongue. Specific gravity 2.13. Soluble in acids. Its constituents are magnesia 70, water 30, which approaches to 1 prime equivalent of each.

MAGNESIAN *limestone*, or DOLOMITE, a species of marble found in the Alps, and in Icolmkill in Scotland, and also in Nottinghamshire and Derbyshire. Its constituents, according to Mr. Tennant, are,

Magnesia,	20.3 to 20.5.
Lime,	29.5 to 30.7.
Carbonic acid,	47.2.
Clay and oxide of iron,	0.8.

MAGNETISM. The natural magnet, or loadstone, is a hard mineral body of a dark brown, or almost black colour, and when examined, is found to be an ore of iron. It is met with in various countries, generally in iron mines, and of all sizes and forms.

It is not precisely known when and by whom the directive property of the magnet was discovered. The most probable accounts seem to prove, that it was known early in the 13th century; and that the person who first made mariners' compasses, at least in Europe, was a Neapolitan of the name of Flavio, or John de Gioga, or Giova, or Gira.

The natural loadstone has also the quality of communicating its properties to iron and steel; and when pieces of steel properly prepared are touched, as it is called, by the loadstone they are denominated artificial magnets.

These artificial magnets are even capable of being made more powerful than the natural ones; and as they can be made of any form, and are more convenient, they are now universally used, so that the loadstone or natural magnet is only kept as a curiosity.

All magnets, whether natural or artificial, are distinguished from other bodies by the following characteristics.

1. A magnet attracts iron.

2. When a magnet is placed so as to be at liberty to move freely in every direction, its ends point towards the poles of the earth, or very nearly so; and each end always points to the same pole. This is called the polarity of the magnet; the ends of the magnet are called poles; and they are called north and south poles of the magnet, according as they point to the north or south pole of the earth. When a magnet places itself in this direction, it is said to traverse.

3. When the north pole of one magnet is presented to the south of another magnet, these ends attract each other; but if the south pole of one magnet is presented to the south pole of another, or the north pole of one to the north pole of another, these ends will repel each other.

4. When a magnet is situated so as to be at liberty to move itself with sufficient freedom, its two poles do not lie in a horizontal direction, but it generally inclines one of them towards the horizon, and of course it elevates the other pole above it. This is called the inclination or dipping of the magnet.

5. Any magnets may, by proper methods, be made to impart those properties to iron or steel.

A plai perpendicular to the ho, and passing through the poles of a magnet when standing in their natural direction, is called the magnetic meridian; and the angle which the magnetic meridian makes with the meridian of the plane where the magnet stands, is called the declination of the magnet at that place.

Magnetic Attraction and Repulsion.

When a piece of iron is brought within a certain distance of one of the poles of a magnet, it is attracted by it; and if the iron is at liberty to move, it adheres to the magnet, and cannot be separated without some force. It appears at first sight, that the attraction lies only in the magnet, but experiment proves this attraction to be mutual: the iron attracting the magnet as much as the magnet attracts the iron. This attraction is strongest at the poles of a magnet, and diminishes in proportion to the distance of any part from the poles, so that in the middle between the poles there is no attraction. The intensity of the attractive power diminishes also, according to the distance from the magnet.

As magnetic attraction takes place only between poles of different names of different magnets; consequently magnetic repulsion acts only between poles of the same name of different magnets. When a piece of iron is brought within a certain distance of a magnet, it becomes, in fact, itself a magnet, having the polarity, the attractive and repulsive properties for other iron, &c. Thus if A B, plate XXVIII, fig. 1, be an oblong piece of iron, and be brought near the north pole N of the magnet N S, this piece of iron while standing within the magnet's sphere of action, will have all the properties of a real magnet, and its end A will be found to be a south pole, while the end B is a north pole. Soft iron, when placed within the influence of a magnet, easily acquires these properties; but they last only while the iron remains in that situation, and when it is removed its magnetism vanishes immediately. But with iron containing carbon, and particularly with steel, the case is very different; and the harder the iron or the steel is, the more permanent is the magnetism which it acquires from the influence of a magnet; but it will be in the same proportion more difficult to render it magnetic. Neither the magnetic attraction nor repulsion is in the least diminished, or at all affected, by the interposition of any sort of bodies, except iron, or such bodies as contain iron.

The properties of the magnet are not affected either by the presence or by the absence of air. Heat weakens the power of a magnet, and subsequent cooling restores it, but not quite to its former degree. A white heat destroys it entirely, or very nearly so; and hence it appears, that the powers of magnets must be varying continually.

The attractive power of a magnet may be considerably improved by suspending a weight of iron to it by its power of attraction, which may be gradually increased; and also by keeping it in a proper situation, viz. with its north pole towards the north, and its south pole, consequently, towards the south. On the contrary, this power is diminished by an improper sit tion, and by keeping too small a piece of iron, or no iron at all, appended to it.

Amongst the natural magnets, the smallest generally possess a greater attractive power in proportion to their size than those of a larger size. It frequently happens that a natural magnet, cut off from a larger loadstone, will be able to lift a greater weight of iron than the original loadstone itself. As both magnetic poles together attract a much greater weight than a single pole; and as the two poles of a magnet generally are in opposite parts of its surface, in which case it is almost impossible to adapt the same piece of iron to them both at the same time; therefore it has be monly practised to adapt two broad pieces of soft iron to the poles of the stone, and to let them project on one side of the stone; for those pieces become themselves magnetic while thus situated, and to them the piece of iron or weight may be easily adapted. Those two pieces of iron are generally fastened upon the stone by means of a brass or silver box. The magnet in this case is said to be armed; and the two pieces of iron are called the armature.

Fig. 2 represents an armed magnet, where A B is the loadstone; C D, CD, are the armature, or the two pieces of soft iron, to the projections of which DD the iron weight F is to be applied. The dots ECDCD represent the brass box, with a ring at E, by which the armed magnet may be suspended.

Of the Polarity of the Magnet.

Every magnet has a south and north pole, which are at opposite ends; and a line drawn from one end to the other, passes through the centre of the magnet. Here it must not be understood, that the polarity of a magnet resides

only in two points of its surface; for in reality, it is the one half of the magnet that is possessed of one kind of polarity; and the other half of the other kind of polarity; the poles, then, are those points in which that power is the strongest.

It is the polarity of the magnet that renders it so useful to navigators. When a magnet is kept suspended freely, so that it may turn north and south, the pilot by looking at the position of it, can steer his course in any required direction. Although the north pole of the magnet in every part of the world, when suspended, points towards the northern parts, and the south pole towards the southern parts, yet its ends seldom point exactly towards the poles of the earth. The angle in which it deviates from due north and south, is called the angle of declination, or the declination of the magnetic needle, or the variation of the compass; and this declination is said to be east or west, according as the north pole of the needle is eastward or westward of the astronomical meridian of the place. This deviation from the meridian is not the same in all parts of the world, but is different in different places, and it is even continually varying in the same place.

The declination from the meridian, and the variation of this in different parts of the world, are very uncertain, and have hitherto formed a great impediment to the improvement of navigation. This however is likely to be in a great measure removed, by the successful experiments of Mr. Barlow, on the local attraction of vessels. When the variation was first observed, the north pole of the magnetic needle declined eastward of the meridian of London; but it has since that time been changing continually towards the west; so that in the year 1657 the magnetic needle pointed due north and south. At present it declines about 24½° westward, but seems to be returning again towards the east. Before volcanic eruptions and earthquakes, the magnetic needle is often subject to very extraordinary movements. It is also agitated before and after the appearance of the aurora borealis; a circumstance which indicates a near affinity between electricity and magnetism.

Inclination or dip of the magnetic Needle.

If a needle which is accurately balanced, and suspended so as to turn freely in a vertical plane, is rendered magnetical, the north pole will be depressed, and the south pole elevated above the horizon; this property is called the inclination, or dip of the needle, and was discovered by Robert Norman, about the year 1576.

Take a globular magnet, or an oblong one, like SN, fig. 4; the extremity N of which is the north pole, the other extremity S is the south pole, and A is its middle or equator; place it horizontally upon a table CD: then take another small oblong magnet *n s*, and suspend it by means of a fine thread tied to its middle, so as to remain in an horizontal position, when not disturbed by the vicinity of iron. Now if the same small magnet, held by the upper part of the thread, be brought just over the middle of the large magnet, within two or three inches of it, the former will turn its south pole *s*, towards the north pole, N. of the large magnet, and its north pole *n*, towards the south pole S of the large one. It will be farther observed, that the small magnet, whilst kept just over the middle A of the large one, will remain parallel to it; but if the small magnet be moved a little nearer to one end than to the other of the large magnet, then one of its poles, namely, that which is nearest to the contrary pole of the large magnet, will be inclined downwards, and of course the other pole will be elevated above the horizon. If the small magnet be brought just opposite to one of the poles of the large magnet, it will turn the contrary pole towards it, and will place itself in the same straight line with the axis of the large magnet.

To communicate the magnetic virtue.

There are various methods of giving the magnetic property to steel or iron. Take a bar of iron three or four feet long, and hold it in a vertical position, you will find that the bar is magnetic. If the bar be inverted, polarity will be instantly reversed: the extremity which is now lowest, will be found to be a north pole, and the other extremity will be a south pole.

Bars of iron that have stood in a perpendicular position, are generally found to be magnetical, as fire-irons, bars of windows, &c. If a long piece of hard iron is made red-hot, and then left to cool in the direction of the magnetical line, it becomes magnetical. Striking an iron bar with a hammer, or rubbing it with a file, while held in this direction, likewise renders it magnetical. An electric shock produces the same effect; and lightning often renders iron magnetic. A magnet cannot communicate a degree of magnetism stronger than that which itself possesses; but two or more magnets, joined together, may communicate a greater power to a piece of steel, than either of them possesses singly.

1. Place two magnetic bars, A, B, fig. 5, in a line with the north end of one, opposed to the south end of the other; but at such a distance from each other, that the magnet to be touched may rest with its north end on the south end of A, and *vice versa*, then apply the north end of the magnet E, and the south end of D, to the middle of the bar C, the opposite ends being elevated as in the figure; draw E and D asunder along the bar C, one towards A, the other towards B, preserving the same elevation; remove E and D a foot or two from the bar when they are off the ends, then bring the north and south poles of these magnets together, and apply them again to the middle of the bar C as before: repeat the same process five or six times, then turn the bar and touch the opposite surface in the same manner, and afterwards the two remaining surfaces; by this means the bar will acquire a strong fixed magnetism.

2. Place the two bars which are to be touched parallel to each other; and then unite the ends by two pieces of soft iron, called supporters, in order to preserve, during the operation, the circulation of the magnetic matter; the bars are to be placed so that the end D, fig. 6, may be opposite the end B; then place the two attracting poles G and I on the middle of one of the bars to be touched, raising the ends, so that the bars may form an obtuse angle of 100 or 120 degrees; the ends G and I of the bars are to

be separated two or three tenths of an inch from each other. Keeping the bars in this position, move them slowly over the bar AB, from one end to the other, going from end to end about fifteen times. Having done this, change the poles of the bars, and repeat the same operation on the bar CD, and then on the opposite faces of the bars. The touch thus communicated may be further increased, by rubbing the different faces of the bars with sets of magnetic bars, disposed as in fig. 7.

It may, perhaps, be necessary to say something concerning the communication of magnetism to crooked bars like ABC, fig. 8. Place the bar flat upon a table, and to its extremities apply the magnetic bars DF, EG; joining their extremities FG, with the conductor or piece of soft iron FG; then to its middle apply the magnetic bars placed at an angle; or you may use two bars only, placed as shewn in fig. 9, and stroke the crooked bar with them from end to end, following the direction of that bent bar; so that on one side of it the bars may stand in the direction of the dotted representation LK. In this manner, when the piece of steel ABC has been rubbed a sufficient number of times on one side, it must be turned with the other side upwards, &c.

The magnetic needles, which are commonly used at sea, are between four and six inches long; but those which are used for observing the daily variation, are made a little longer, and their extremities point the variation upon an arch or circle properly divided and affixed to the box. The best shape of a magnetic needle is represented in figs. 9 and 10; the first of which shews the upper side, and the second shews a lateral view of the needle, which is of steel, having a pretty large hole in the middle, to which a conical piece of agate is adapted by means of a brass piece O, into which the agate-cap is fastened. Then the apex of this hollow cap rests upon the point of a pin F, which is fixed in the centre of the box, and upon which the needle, being properly balanced, turns freely.

A mariner's compass, or compass generally used on board of ships, is represented in fig. 11. The box, which contains the card or fly with the needle, is made of a circular form, and either of wood, or brass, or copper. It is suspended within a square wooden box, by means of two concentric circles, called gimbalds, so fixed by cross axes to the two boxes, that the inner one, or compass-box shall retain a horizontal position in all motions of the ship. The compass-box is covered with a pane of glass, in order that the motion of the card may not be disturbed by the wind. See fig. 12. What is called the card is a circular piece of paper, which is fastened upon the needle, and moves with it. The outer edge of this card is divided into 360 equal parts or degrees, and within the circle of those divisions it is again divided into 32 equal parts, which are called the points of the compass, or rhumbs, each of which is often subdivided into quarters. The initial letters N, NE, &c. are annexed to those rhumbs, to denote the north, north east, &c.

The azimuth compass is nothing more than the above-mentioned compass, to which two sights are adapted, through which the sun is to be seen, in order to find its azimuth, and from thence to ascertain the declination of the magnetic needle.

MAGNETISM *electro*. Among the numerous and important discoveries of the present age, deserves to be ranked the subject of Electro Magnetism, a name given to a class of phenomena first observed by M. Oersted of Copenhagen, in 1819 20, and since then very fully illustrated by M. Ampere, M. Arago, Sir H. Davy, Dr. Wollaston, Mr. Farady, Mr. De la Rive, but more fully still by Mr. Peter Barlow, of the Royal Military Academy, who has published a course of experiments in the science, and described the theory of it, in his excellent Essay on Magnetic Attractions, second edition.

On this subject our limits will only permit us to give the following outline; but the student, who is desirous of more minute information, may profitably consult Mr. Barlow's Essay, and also the supplement to Mr. Partington's Introduction to Electricity.

Let the opposite poles of a voltaic battery be connected by a metallic wire, which may be left of such length as to suffer its being bent or turned in various directions. This is the conjunctive wire of M. Oersted. Let us suppose that the rectilinear portion of this wire is extended horizontally in the line of the magnetic meridian. If a freely suspended compass needle be now introduced, with its centre *under* the conjunctive wire, the needle will instantly deviate from the magnetic meridian; and it will decline towards the *west*, under that part of the conjunctive wire which is nearest the negative electric pole, or the copper end of the voltaic apparatus. The amount of this declination depends on the strength of the electricity, and the sensibility of the needle. Its *maximum* is 90° We may change the direction of the conjunctive wire, out of the magnetic meridian, towards the east or the west, provided it remains above the needle, and parallel to its plane, without any change in the above result, except that of its amount. Wires of platinum, gold, silver, brass, and iron, may be equally employed; nor does the effect cease though the electric circuit be partially formed by water. The effect of the conjunctive wire takes place across plates of glass, metal, wood, water, resin, pottery, and stone. If the conjunctive wire be disposed horizontally *beneath* the needle, the effects are of the same nature as those which occur when it is *above* it; but they operate in an inverse direction; that is to say, the pole of the needle, under which is placed the portion of the conjunctive wire which receives the negative electricity of the apparatus, declines in that case towards the *east*.

To remember these results more readily, we may employ the following proposition: *The pole* ABOVE, *which the negative electricity enters, declines towards the* WEST; *but if it enters* BENEATH *it, the needle declines towards the* EAST.

If the conjunctive wire (always supposed horizontal) is slowly turned about, so as to form a gradually increasing angle with the magnetic meridian, the declination of the needle increases, if the movement of the wire be towards the line of position of the disturbed needle; it diminishes, on the contrary, if it recede from its position. When the conjunc-

tive wire is stretched along-side of the needle in the same horizontal plane, it occasions no declination either to the east or west; but it causes it merely to incline in a vertical line, so that the pole adjoining the negative influence of the pile on the wire dips when the wire is on its west side, and rises when it is on the east. If we stretch the conjunctive wire, either above or beneath the needle, in a plane perpendicular to the magnetic meridian, it remains at rest, unless the wire be very near the pole of the needle; for, in this case, it rises when the entrance takes place by the west part of the

ceive the electricity of the negative end of the battery, the pole of the needle moves towards the *east*; but if we place the wire opposite a point betwixt the pole and the middle of the needle, it moves to the *west*. The phenomena are presented in an inverse order, when the upper extremity of the conjunctive wire receives the electricity of the positive side of the apparatus.

It appears from the preceding facts, says M. Oersted, that the electric conflict (action) is not enclosed within the conducting wire, but that it has a pretty extensive sphere of activity round it. We may also conclude from the observations, that this conflict acts by revolution; for without this supposition we could not comprehend how the same portion of the conjunctive wire, which, placed *beneath* the magnetic pole, carries the needle towards the east, when it is placed *above* this pole, should carry it towards the west. But such is the nature of the circular action, that the movements which it produces take place in directions precisely contrary to the two extremities of the same diameter. It appears also, that the circular movement, combined with a progressive movement in the direction of the length of the conjunctive wire, ought to form a kind of action, which operates *spirally* around this wire as an axis.

The magnetic property may be communicated to a steel needle, or to several needles at once, by the following simple process. Let the conducting wire have one part of it bent into a spiral form, by twisting twenty or thirty times round a ruler of about an inch in diameter, and let the needle be placed either naked in the spiral, or enclosed in a glass tube, or in a tube of any other matter; complete the connexion between the ends of the battery, and in an instant it will be found that the needle has become strongly magnetic, having its north pole towards the zinc extremity of the battery. The same effect may be produced by the discharge of an electrical battery.

Magnetism, *animal*, or, as it has been by some termed, **Mesmerism**, is a pretended science, which some time ago excited much attention in many parts of Europe, and which has still its professors and lecturers in some of the German universities. This doctrine originated with Father Hehl, a German philosopher, who, in 1774, strongly recommended the use of the magnet in medicine; but the founder of the imposture in question was one Mesmer, a physician of the same country, who went to Paris, and flourished in a very extraordinary manner about the years 1778 and 1779. M. Deslon, pupil and coadjutor of Mesmer, is said to have realized 100,000*l.* sterling by his practice; and this person, in explaining the principles of his art, asserted, "That animal magnetism is a universal fluid, constituting an absolute plenum in nature, and the medium of all natural influence between the celestial bodies, and the earth and animal bodies. That it is the most subtile fluid in nature. That the animal body is subjected to the influence of this fluid by means of the nerves, which are immediately affected by it. That the human body, and other bodies, have poles analagous to the magnet. That the virtue of animal magnetism may be communicated from one body to another, either animate or inanimate. That by means of this fluid nervous disorders are cured immediately, and others mediately; and its virtues extend to the universal cure and preservation of mankind," &c.

It is a lamentable case, that, throughout the world, impositions of this nature are always tolerated long enough to answer the purposes of the fabricator, and to encourage others in similar deceptions. Our readers may recollect many instances of notorious character, among which the metallic tractors, which were at one time asserted to be allied to metallic-magnetism, may, perhaps, serve as a proper illustration and proof.

MAGNIFYING, in philosophy, the making of objects appear larger than they would otherwise do; whence convex lenses, which have the power of doing this, are called magnifying glasses; and of such glasses are microscopes constructed.

MAGNITUDE, whatever is made up of parts locally extended, or that has several dimensions; as a line, surface, solid, &c. The apparent magnitude of a body is that measured by the visual angle, formed by rays drawn from its extremes to the centre of the eye; so that whatever things are seen under the same or equal angles, appear equal; and vice versa.

MAGNOLIA, a genus of the polygynia order, belonging to the polyandria class of plants; and in the natural method ranking under the 52d order, coadnatæ. The calyx is triphyllous; there are nine petals; the capsules bivalved and imbricated; the seeds pendulous, and in the form of a berry. There are seven species: the principal are,

1. The *glauca*, or small magnolia, a native of Virginia, Carolina, and other parts of North America. In moist places it rises from seven or eight to fifteen or sixteen feet high, with a slender stem. The wood is white and spongy, the flowers are produced at the extremities of the branches, are white, composed of six concave petals, and have an agreeable scent. 2. The *grandiflora*, or great magnolia, is a native of Florida and South Carolina. It rises to the height of eighty feet or more, with a straight trunk upwards of two feet diameter, having a regular head. The leaves resemble those of the laurel, but are larger, and continue green throughout the year. The flowers are produced at the ends of the branches, and are of a purplish-white colour.

MAHOGANY. See **Swietenia.**

MAHOMETANS, believers in the doctrines and divine mission of Mahomet, the celebrated

warrior and pseudo-prophet of Arabia. In the Mahometan religion we find a prodigious number of rites, ceremonies, and observations, the principal of which are: circumcision, ablutions, fastings, pilgrimage, polygamy, marriage rites, mourning for the dead, funeral rites, and the observance of Friday as a sabbath. See KORAN.

MAIDEN, the name of an ancient instrument for beheading criminals. It is thus described by Mr. Pennant. "This machine of death is now destroyed; but I saw one of the same kind in a room under the parliament house at Edinburgh, where it was introduced by the regent Morton, who took a model of it as he passed through Halifax, and at length suffered by it himself. It is in form of a painter's easel, and about ten feet high: at four feet from the bottom is a cross bar, on which the felon lays his head, which is kept down by another placed above. In the inner edges of the frame are grooves; in these is placed a sharp axe, with a vast weight of lead, supported at the very summit with a peg: to that peg is fastened a cord, which the executioner cutting, the axe falls, and does the affair effectually, without suffering the unhappy criminal to undergo a repetition of strokes, as has been the case in the common method. I must add, that if the sufferer is condemned for stealing a horse or cow, the string is tied to the beast, which, on being whipped, pulls out the peg, and becomes the executioner." This apparatus is now in the possession of the Scottish Antiquarian Society.

MAJESTY, a title given to kings, which frequently serves as a term of distinction.

MAIHEM, or *Maim*, signifies a corporal wound or hurt, by which a man loseth the use of any member. If a man attack another with intent to murder him, and he does not murder the man, but only maim him, the offence is a capital felony; and if any person shall, wilfully maliciously, and unlawfully, shoot at any of his majesty's subjects, or present any kind of loaded fire-arms at any one, and attempt to discharge the same at him, stab or cut any of his Majesty's subjects, with intent to murder or rob, or to maim, disfigure, or disable him, or to do some grievous bodily harm to him, or to obstruct, resist, or prevent the lawful apprehension and detainer of the person so stabbing or cutting, or any of his accomplices, or shall administer poison with intent to murder, or procure the miscarriage of any woman quick with child, he shall be guilty of felony and suffer death.

MAINPRIZE, a delivering a person to his friends, to be answerable for his appearance.

MAINTENANCE, the unlawful taking in hand or upholding a cause of any person. It was formerly unlawful to assist any person in litigation, except as an attorney, advocate, kinsman, servant, or near relation out of charity.

MAJOR, in the art of war, the name of several officers of very different ranks and functions; as, 1. Major-general, the next officer to the lieutenant-general: his chief business is to receive the orders from the general, or in his absence from the lieutenant-general of the day; which he is to distribute to the brigade majors, with whom he is to regulate the guards, convoys, and detachments. When there are two attacks at a siege, he commands that on the left. He ought to be well acquainted with the strength of each brigade, of each regiment in particular, and to have a list of all the field officers. 2. Major of a brigade, the officer who receives the orders from the major-general, and afterwards delivers them to the adjutants of the regiments at the head of the brigade; where he takes and marches the detachments, &c. to the general rendezvous. 3. Major of a regiment, the next officer to the lieutenant-colonel, generally promoted from the oldest captain. He is to take care that the regiment be well exercised, to see it march in good order, and to rally it in case of its being broken. 4. Major of a regiment of horse, is the first captain, who commands in the absence of the colonel. 5. Town-major, the third officer of a garrison, being next to a deputy-governor.

There are also drum-majors, &c. so called from their pre-eminence above others of the same denomination.

MALACHOA, a genus of the class and order monadelphia polyandria. The cal. is common, three-leaved, many-flowered, longer; arils, 5, one-seeded. There are five species, herbs of the West Indies.

MALACHITE, a mineral, the green carbonate of copper, found frequently crystallized in long slender needles; colour green, and the specific gravity about 3.6. It efferverses with nitric acid, and gives a blue colour to ammonia. It decrepitates and blackens before the blowpipe. There are two varieties, the fibrous and the compact; the constituent parts are:—copper, 58.0; carbonic acid, 18.0; oxygen, 12.5; water, 11.5.

MALACOLITE, a mineral found in the silver mines in Sweden, and also in Norway. It is obtained massive and crystallized in six-sided prisms. Specific gravity about 3.25. It consists of silica 53, lime 20, magnesia 19, alumina 3, oxide of iron, &c.

MALATES, in chemistry, salts formed by the union of the malic acid with different bases. The malates of potash, soda, and ammonia, are deliquescent. The malates of potash, soda, ammonia, lime, and barytes, may be formed by dissolving these alkalis in malic acid, and evaporating the solutions.

MALE, among zoologists, that sex of animals which has the parts of generation without the body.

The term male has also, from some similitude to that sex in animals, been applied to several inanimate things; thus we say, a male flower, a male screw, &c.

MALIC *acid*, in chemistry, was discovered by Scheele about the year 1785. It is found in the juices of a great many fruits, and it derives its name from the circumstance of its being obtained in great abundance from the juice of apples, in which it exists ready formed.

The French chemists have ascertained that it may be obtained in the largest quantities from the juice of the sempervivum tectorum, where it exists abundantly combined with lime. Malic acid is very soluble in water, and decomposes spontaneously, by undergoing a kind of fermentation. It is composed of oxygen, hydrogen, and carbon. It combines with alkalis, earths, and metallic oxides, and forms MALATES.

MALLEABLE, a property of metals, whereby they are capable of being extended under the hammer.

MALOPE, a genus of the class and order monadelphia polyandria. The calyx is double, outer three-leaved; arils glomerate, one-seeded. There are two species, herbs of Tuscany, &c.

MALPIGHIA, *Barbadoes cherry*, a genus of the trigynia order, in the decandria class of plants, and in the natural method ranking under the 23d order, trihilatæ. There are 18 species, all of them shrubby evergreens of the warm parts of America, rising with branchy stems from 8 or 10 or 15 or 20 feet high, ornamented with oval and lanceolate entire leaves, and large pentapetalous flowers, succeeded by red, cherry-shaped, eatable berries, of an acid and palatable flavour: and which in the West Indies, where they grow naturally, are used instead of cherries.

MALT, is barley prepared, to fit it for making a potable liquor called beer, or ale, by stopping it short at the beginning of vegetation. In making malt from barley, the usual method is to steep the grain in a sufficient quantity of water, for two or three days, till it swells, becomes plump, somewhat tender, and tinges the water of a bright-brown, or reddish colour. Then this water being drained away, the barley is removed from the steeping cistern to the floor, where it is thrown into what is called the wet couch; that is, an even heap, rising to the height of about two feet. In this wet couch the capital part of the operation is performed; for here the barley spontaneously heats, and begins to grow, shooting out first the radicle; and if suffered to continue, then the plume, spire, or blade. But the process is to be stopped short at the eruption of the radicle, otherwise the malt would be spoiled. In order to stop it, they spread the wet couch thinly over a large floor, and keep turning it once in four or five hours, for the space of two days, laying it somewhat thicker each time. After this, it is again thrown into large heaps, and there suffered to grow sensibly hot to the hand, as it usually will in 20 or 30 hours time; then being spread again, and cooled, it is thrown into the kiln, to be dried crisp without scorching.

MALTA, KNIGHTS OF, or otherwise called *hospitalers of St. John of Jerusalem*, a religious military order, whose residence is in the Island of Malta. The order consisted of three estates, the knights chaplains, and servants at arms: there are also priests who officiate in the churches, friar-servants who assist at the offices, and donnes or demicrosses, but these are not reckoned constituent parts of the body; the government of the order was partly monarchical, and partly aristocratical; the grand master being sovereign. None are admitted into this order but such as are of noble birth.

MALTHA, in antiquity, a kind of cement, of which there were two sorts, native and factitious: one of the latter sort, much in use, consisted of pitch, wax, plaister, and grease. Another kind used by the Romans in their aqueducts, was made of lime slacked in wine, incorporated with melted pitch, and fresh figs. Natural maltha is a kind of bitumen, with which the Asiatics plaister their walls; and which being once set on fire, water makes it burn more fiercely.

MALVA, the *mallow*, a genus of the polyandria order, in the monadelphia class of plants, and in the natural method ranking under the 37th order, columniferæ. The calyx is double the exterior one triphyllous; the arilla numerous and monospermous. There are 34 species, consisting of herbaceous perennials, biennials, and annuals, for medical, economical, and ornamental uses.

MAMALUKES, the name of a dynasty that reigned in Egypt. The Mamalukes were originally Turkish and Circassian slaves, bought of the Tartars by Melicsaleh, to the number of a thousand, whom he bred up to arms, and raised some to the principal offices of the empire. They killed Sultan Mondam, whom they succeeded.

Some say that the Mamalukes were ordinarily chosen from among the Christian slaves, and that they were the same with the Janissaries among the Turks. They never married: they first are said to have been brought from Circassia, and some have supposed that they began to reign about the year 869.

MAMMÆ, the breasts, in anatomy. See MAMMARY *gland*.

MAMMALIA, the first class of animals in the Linnæan system: the animals in this class have lungs that respire alternately; jaws incumbent, covered; teeth usually within; teats lactiferous; organs of sense, tongue, nostrils, eyes, ears, and papillæ of the skin; coverings, hair, which is scanty in warm climates, and scarcely any on aquatics; supporters, four feet, except in aquatics, and in most a tail; walk on the earth and speak. Such is the Linnæan account. They suckle their young by means of lactiferous teats, and hence the name mammallia. In structure they resemble man; most of them are quadrupeds, and with man inhabit the surface of the earth: a few of them exist in the ocean. There are seven orders, the characters of which are taken from the number situation, and structure of the teeth. The names of the orders are:—

Belluæ,
Bruta,
Cete,
Feræ,
Glires,
Pecora,
Primates,

which see.

MAMMARY *gland*, in anatomy, is a glandular substance situated in the breast, and secreting the milk.

This gland, surrounded by cellular and adipous substance, and covered by the common integuments, constitutes the breast. It lies on the anterior surface of the pectoralis major muscle.

MAN. See ZOOLOGY.

MANDAMUS, is a writ issuing in the king's name out of the court of king's bench, and directed to any person, corporation, or inferior court of judicature, commanding to some particular thing therein specified, as appertaining to their office and duty.

MANDRAKE. See ATROPA.

MANDREL, a kind of wooden pulley, making a member of the turner's lathe, of which there are several kinds, as the flat mandrels, which have three or more little pegs or points near the verge, and are used for turning flat boards on; the pin mandrel are those which have a long wooden shank to fit into a large hole made in the work to be turned; hollow

mandrels are those hollow of themselves, and used for turning hollow work; screw mandrels for turning screws, &c.

MANETTIA, a genus of the class and order tetrandria monogynia. The calyx is eight-leaved: corolla four-cleft; capsule inferior, two-valved, one-celled; seeds imbricate, unilocular. There are three species, shrubs of the West Indies.

MANGANESE. 1. The dark grey, or brown mineral called manganese has been long known and used in the manufacture of glass. A mine of it was discovered in England by Mr. Boyle. A few experiments were made upon this mineral by Glauber in 1656. Manganese, when pure, is of a greyish-white colour, and has a good deal of brilliancy. Its texture is granular. It has neither taste nor smell. Its hardness is equal to that of iron. Its specific gravity is 8.0. It is very brittle; and can neither be hammered, nor drawn out into wire. Its tenacity is unknown. It requires, according to Morveau, the temperature of 160° Wedgewood to melt it; so that, platinum excepted, it is the most infusible of all the metals. When reduced to powder it is attracted by the magnet, owing probably to a small portion of iron from which it can with difficulty be parted. Manganese, when exposed to the air, attracts oxygen more rapidly than any other body, phosphorus excepted. It loses its lustre almost instantly, becomes grey, violet, brown, and at last black. These changes take place still more rapidly if the metal is heated in an open vessel.

Concentrated sulphuric acid attacks manganese, at the same time that hydrogen gas is disengaged. If sulphuric acid be added, and drawn off by distillation several times from the black oxide, by a heat nearly approaching to ignition, in a glass vessel, it is found that oxygen gas is disengaged toward the end of each process, and part of the oxide is dissolved. The solution of the sulphate made from the metal itself is colourless. If it be made from the black oxide, it is a purplish red; but this colour is destroyed by the light of the sun, and again restored by removing the solution into the dark. Sulphurous acid dissolves the oxide, taking part of its oxygen, which converts it into sulphuric acid, thus forming a sulphate with the remaining oxide. Nitric acid dissolves manganese with effervescence, and the escape of nitrous gas. A spongy, black, and friable matter remains, which is a carburet of iron. The solution does not afford crystals. The oxide is more readily soluble in nitrous acid. Manganese is dissolved in the usual manner by muriatic acid. The solution of manganese in muriatic acid scarcely affords crystals; but a deliquescent saline mass by evaporation, which is soluble in alcohol. In the dry way, the oxide of manganese combines with such earths and saline substances as are capable of undergoing fusion in a strong heat. These experiments are most advantageously performed by the blowpipe, which see. This metal melts readily with most of the other metals, but rejects mercury. Gold and iron are rendered more fusible by a due addition of manganese; and the latter metal is rendered more ductile. Copper becomes less fusible, and is rendered whiter, but of a colour subject to tarnish.

The ore of manganese, which is known in Derbyshire by the name of *black wadd,* is remarkable for its spontaneous inflammation with oil. It is of a dark-brown colour, of a friable earthy appearance, partly in powder, and partly in lumps. If half a pound of this be dried before a fire, and afterward suffered to cool for about an hour, and it be then loosely mixed or kneaded with two ounces of linseed oil; the whole, in something more than half an hour, becomes gradually hot, and at length bursts into a flame. This effect wants explanation. It seems, in some measure, to resemble the inflammation of oils by the nitric acid. Manganese was used chiefly by glass-makers and potters, but the important discovery of chlorine has greatly extended its utility.

MANGIFERA, the *Mango-tree*, a genus of the monogynia order, in the pentandria class of plants, and in the natural method ranking with those of which the order is doubtful. The corolla is pentapetalous; the plum kidney-shaped. There are three species, the principal of which is a native of many parts of the East Indies, whence it has been transplanted to Brazil, and other warm parts of America.

MANICHEES, in church history, a sect of christian heretics in the third century, the followers of Manes, who pretended to be the Comforter whom our Saviour promised to send into the world. He taught that there are two principles or gods, co-eternal and independent on each other; the one the author of all evil, and the other of all good: a doctrine which he borrowed from the Persian magi.

MANILLE, in commerce, a large brass-ring, in the form of a bracelet, either plain or engraven, flat or round. Manilles are the principal commodities which the Europeans carry to the coast of Africa, and exchange with the natives for slaves. These people wear them as ornaments on the small of the leg and on the thick part of the arm above the elbow.

MANIPULUS, in Roman antiquity, a body of infantry, consisting of 200 men, and constituting the third part of a cohort.

MANIS, a genus of quadrupeds of the order of bruta. The generic character is, teeth none; tongue cylindric and extensile; mouth narrowed into a snout; body covered with scales. The genus manis presents an appearance not less extraordinary than that of dasypus or armadillo; being covered on every part, except on the belly, with strong and large horny scales, constituting a suit of armour, and capable of defending the animal when rolled up,

1. *Manis tetradactyla*, long-tailed manis, known in India by the name of the phatagen, is of a very long and slender form: the head is small; the snout narrow; the whole body, except beneath, covered with broad but sharp-pointed scales, which are striated throughout their whole length; the tail is more than twice the length of the body, and tapers gradually to the tip. The legs are very short, scaled like the body, and on each of the feet are four claws, of which those on the fore-feet are much stronger then those of the hind. The colour of the whole animal is an uniform deep brown.

2. *Manis pentadactyla*, short-tailed manis, differs from the former, in being of a much thicker and shorter form; the tail in particular, differs greatly in proportion from that of the preceding, being not so long as the body, very thick at the base, and thence gradually tapering, but terminating very obtusely. The head is

small as in the former; the ears small and rounded; the feet furnished with five toes each, of which those on the fore feet are extremely strong, except the exterior one, which is much smaller than the rest. The whole animal is covered with thick, strong, and large scales, which in the full grown specimens are perfectly smooth, but in those which are smaller are slightly striated about half way from the base.

MANNA. Several vegetables afford manna; but the ash, the larch, and the alhagi, afford it in the largest quantities. The ash which affords manna grows naturally in all temperate climates; but Calabria and Sicily appear to be the most natural countries to this tree. The manna flows naturally from the tree, and attaches itself to its sides in the form of white transparent drops; but the extraction of this juice is facilitated by incisions made in the tree during summer. Its smell is strong, and its taste sweetish and slightly nauseous: if exposed on hot coals, it swells up, takes fire, and leaves a light bulky coal. Water totally dissolves it, whether hot or cold. If it be boiled with lime, clarified with white of egg, and concentrated by evaporation, it affords crystals of sugar. Manna affords, by distillation, water, acid, oil, and ammonia; its coal affords fixed alkali. This substance forms the basis of many purgative medicines.

MANOMETER, or *Manoscope*, an instrument to shew or measure the alterations in the rarity or density of the air. It differs from the barometer in this, that the latter only serves to measure the weight of the atmosphere, but the former the density of the air in which it is found; which density depends not only on the weight of the atmosphere, but also on the action of heat, cold, &c.

MANOR, was a district of ground held by lords or great personages, who kept in their own hands so much land as was necessary for the use of their families, which were called terræ dominicales, or demesne lands. The other lands they distributed among their tenants. The residue of the manor being uncultivated, was termed the lord's waste, and served for common of pasture to the lord and his tenants. All manors existing at this day must have existed as early as king Edward the First.

MANSLAUGHTER. See HOMICIDE.

MANTELETS, in the art of war, a kind of moveable parapets, made of planks about three inches thick, nailed one over another, to the height of almost six feet, generally cased with tin, and set upon little wheels, so that in a siege they may be driven before the pioneers, and serve as blinds to shelter them from the enemy's small shot.

MANTIS, a genus of insects of the order hemiptera. The generic character is, head unsteady, armed with jaws, and furnished with palpi or feelers; antennæ setaceous; thorax linear; wings four, membranaceous, convoluted; fore legs, in most species, compressed, serrated beneath, and armed with a single claw and a setaceous, lateral, jointed foot; hind legs smooth, formed for walking. This is one of the most singular genera in the whole class of insects; and imagination itself can hardly conceive shapes more strange than those exhibited by some particular species. The chief European kind is the mantis oratoria of Linnæus, or camel cricket, [illegible]s often called. This is found in most of the warmer parts of Europe, and is of a beautiful green colour. It is nearly three inches in length, of a slender shape, and in its general sitting posture is observed to hold up the two fore legs, slightly bent, as if in an attitude of prayer. In its real disposition it is very far from sanctity, preying with great rapacity on any of the smaller insects which fall in its way. It is also of a very pugnacious nature; and when kept with others of its own species in state of captivity, will attack its neighbour with the utmost violence, till one or the other is destroyed in the contest.

MANURES. See AGRICULTURE.

MAP, a plane figure, representing the surface of the earth, or a part thereof. In maps these three things are essentially requisite. 1. That all places have the same situation and distance from the great circles therein, as on the globe, to shew their parallels, longitudes, zones, climates, and other celestial appearances. 2. That their magnitudes be proportionable to their real magnitudes on the globe. 3. That all places have the same situation, bearing, and distance, as on the earth itself.

The true chart performs the first and last of these very exactly, but fails extravagantly in the second; and indeed no kind of projection yet found can exhibit more than two of them at once, by reason of the great difference between a plane and convex superfices. The degrees of longitude are always numbered at top and bottom, and the degrees of latitude on the east and west sides. In all right-lined and general circular maps, except those of Wright's projection, the degrees of latitude on the sides are of an equal breadth; and in all circular and right lined maps, except the said Wright's and the plane charts, the degrees of longitude are unequal.

In general maps. the circles corresponding to those in the heavens are inscribed, viz. the equator is expressed by a straight east and west line; and the first meridian, the polar circles, the tropics, and the other meridians and parallels, which are drawn at every five or ten degrees, intersect each other at right angles. There may be as many different projections as there are points of view in which a globe can be seen, but geographers have generally chosen those which represent the poles at the top and bottom of the map; these from the delineation of the lines of latitude and longitude, are called the stereographic, orthographic, and globular projections.

We shall not detain the reader with a description of all the projections, some of which are so erroneous as to deserve being consigned entirely to oblivion. But as the projection of maps is a pleasing and instructive exercise, and indeed indispensably necessary to the right understanding of geography to students, we shall here subjoin a few examples of construction, which, if the student carefully imitate, he will find little if any difficulty in projecting a map of any given portion of the earth's surface.

Geometrical construction of the Globular Projection.

From the centre C, plate XXIX, fig. 1, with any radius, as CB, describe a circle; draw the diameters AB, and 90, 90, at perfect right angles to one another, and divide them in-

to nine equal parts; likewise divide each quadrant into nine equal parts; each of which contains ten degrees; if the scale admits of it, each of these divisions may be subdivided into degrees; next, to draw the meridian, suppose the meridians 80° W. of Greenwich, we have given the two poles 90, 90, and the point 80 in the equator, or diameter AB; describe a circle to pass through the three given points as follows: with the radius 90 set one foot of the compasses on the point 90, and describe the semicircles XX and ZZ, then remove the compasses to the point 80 on the equator, and describe the arcs, 1, 1, and 2, 2; where they intersect the semicircle; make the point, as at 1 and 2, and draw lines from 2 through the point 1 till they intersect the diameter BA continued in E: then will E be the centre from whence the meridian 90, 80, 90, must be drawn, and will express the meridian of 80° W. longitude from Greenwich; the same radius will draw the meridian expressing 140° W. longitude: in like manner, draw the next meridian with the radius CB, set one foot of the compasses in the point *d*, and describe the arcs *aa* and *bb*, then draw lines as before, which will give the point D, the centre of 90° W, longitude; so of all the rest. The parallels of latitude are drawn in the same manner, with this difference, that the semicircles XX and ZZ must be drawn from the points A and B, the extremities of the equator.

In the manner above described, Mr. Arrowsmith, drew all the meridians and parallels of latitude to every degree on two hemispheres, which laid the foundation of his excellent map of the world.

We shall now shew how the same thing may be done mechanically.

(1) *The Globular Projection of the Sphere on the Plane of a Meridian.*

Draw the circle WNES fig. 2, draw the two diameters NS and WE at right angles with each other.

Divide the arc of each quadrant into nine equal parts.

Divide the radii also in the same manner into ninety equal parts, A *b*.

The diameter N *b* is the meridian, and the diameter WE is the equator.

The other meridians are arcs of circles, for each of which, as we have seen, there are three given points through which it must pass, and those are the two poles NS, and a division on the semi-diameter WC, viz. either *a*, *b*, *c*, *d*, *e*, *f*, *g*, or *h*. The centres for these arcs will be in the line CE produced; and the centres for those on the other side will be on the line CW produced.

For the arc S*a*N. the rad. *aa* = 90,61
— S*b*N. — *bb* = 92,82
— S*c*N. — *cc* = 97,32
— S*d*N. — *dd* = 106
— S*e*N. — *ee* = 121,1
— S*f*N. — *ff* = 149,7
— S*g*N. — *gg* = 215,6
— S*h*N. — *hh* = 410,7

of the par[ts] of which the r[ad]ius contains 90.

And for each of the arcs representing the parallels of lat. also there are three given points, viz. one of the divisions *k*, *l*, *m*, *n*, *o*, *p*, *q*, or *r*, upon the meridian SN, and the two corresponding divisions of the circumference. The centres for these arcs will fall on the line SN, produced both ways, and the following table shews the length of the radius of each equal part, in equatorial degrees, as in the former case.

For the arc

80	*r* 80	the radius	*rr*	=	18,44
70	*q* 70	—	*qq*	=	39,75
66½	A.66½	—	A *Arctic*	=	48,19
60	*p* 60	—	*pp*	=	65,3
50	*o* 50	—	*oo*	=	97,71
40	*n* 40	—	*nn*	=	143
30	*m* 30	—	*mm*	=	210
23½	T. 23½	—	T. *Tropic*	=	281,4
20	*l* 20	—	*ll*	=	337,6
10	*k* 10	—	*kk*	=	708,5

Of the equal parts of which the radius contains 90.

To project a Map of any particular part of the World.

There are several methods of projecting particular parts of the world, we shall notice only two. First, when the meridians and parallels of latitude are right lines.

To project a map of England after this method. England is situated between 2° E. and 6° 20′ W. from Greenwich, and between 50° and 56° N. lat.

Draw a base line AB, plate XXX, fig. 1, in the middle of which erect the perpendicular CD.

Assume a distance for a degree of lat. and set off as many degrees on CD as are wanted, which in this instance are 6; but as a little space beyond the limits of the country is generally left, set off 7.

Through these points draw lines parallel to AB, which will be parallels of latitude.

Respecting the degrees of longitude it must be observed, that on the equator they would be of the same length as they are on a meridian, but must gradually decrease from thence to 0 at the poles.

The following table exhibits the length in geographical miles, of a degree of longitude for every degree of latitude.

Deg Lat.	Geograph. Miles.	Deg. Lat.	Geograph. Miles.	Deg. Lat.	Geograph. Miles.
0	60,00	31	51,43	61	29,09
1	59,99	32	50,88	62	28,17
2	59,96	33	50,32	63	27,24
3	59,92	34	49,74	64	26 30
4	59,85	35	40,15	65	25,36
5	59,77	36	48,54	66	24,41
6	59,67	37	47,92	67	23,41
7	59,56	38	47,28	68	22,48
8	59,42	39	46,63	69	21,50
9	59,28	40	45,96	70	20,52
10	59,00	41	45,28	71	19,53
11	58,90	4	44,59	72	18,54
12	58,69	4.,	43,38	73	17,54
13	58,46	44	43,16	74	18,53
14	58,22	45	42,43	75	15,53
15	57,96	46	41,68	76	14,52
16	57,67	47	40,92	77	13,50
17	57,38	48	40,15	78	12,47
18	57 06	49	39,36	79	11,45
19	56,73	50	38,57	80	10,42
20	56,38	51	38,76	81	9,38
21	56,02	52	36.94	82	8,34
22	55,63	53	26,11	83	7.31
23	55,23	54	35,27	84	6,27
24	54,81	55	34,41	85	5,23
25	54,38	56	33,55	86	4,18
26	53,93	57	32,68	87	3,14
27	53,46	58	31,79	88	2,09
28	52,97	59	30,90	89	1,04
29	52,47	60	30,00	99	0,00
30	51,96				

To use this table, divide the assumed degree into sixty parts by a diagonal line, fig. 2; look for the number of miles answering to the degree of lat. 49, which is 39, 36, say 39½, which take off the scale, fig. 2, at *a*, and set off four times from C towards A, and the same from C towards B. The top meridian is 56° deg. of lat opposite which, in the table, is 33, 35, say 33½, which take from the scale, fig. 9, at *b*, and set off four times from D towards E, and the same from D towards F. Draw the meridian lines to the corresponding divisions at top and bottom, of which 0 0 is the meridian of London.

Secondly. When the meridians and parallels are curved lines.

To project a map of Europe by this method. Draw a base line GH, fig. 3. in the middle of which erect the perpendicular JP, and assume any distance for 10° of latitude.

Europe extends from 36° to 72° N. lat.

Let the point J be 30°, from which set off six of the assumed distances to P, which will be the N. pole.

Number the distances 40, 50, 60, &c.

On the centre P, describe arcs passing through the points of division on the line JP, which will be parallels of latitude.

Divide the space assumed for 10° of lat. into 60 parts by a diagonal line, fig. 11.

Look into the foregoing table for the number of miles answering to 30°, which is 51, 96, say 52, which take from the scale, fig. 4, at *b*.

Set this distance off on the arc 30, 30, from the centre line JP both ways.

Do the same for 40°, 50°, 60°, &c.

Through the corresponding divisions, on all the arcs, draw curve lines; which will represent the meridians.

Number the degrees of lat. and long., which will complete the diagram.

Those who wish to prosecute this interesting branch of science to a greater extent than the above sketch comprehends, may consult with profit Jamieson's Treatise on the Construction of Maps.

MAPLE, in botany, is of the genus Acer. Of the several species the most important is the A. saccharinum, or American sugar apple, from which the Americans derive sugar in large quantities, by tapping the trees early in the spring, and boiling the juice. For this purpose large tracts of lands in North America are devoted to the culture of this tree, which yields a sugar equal to the best cane, and which requires no other labour than what women and girls can bestow, in drawing off and boiling the liquor; and when skilfully tapped, the tree will last many years. A tree of an ordinary size yields in a good season from twenty to thirty gallons of sap, from which may be made from five to six pounds of sugar. The tree is tapped with an auger, first on the south side and then on the north, and the sap will flow five or six weeks according to the temperature of the weather.

MARANTA, *Indian arrow-root*, a genus of the monogynia order, in the monandria class of plants, and in the natural method ranking under the eighth order, scitamineæ. The corolla is ringent and quinquefid, with two segments alternately patent. There are five species, all of them herbaceous perennial exotics of the Indies. They have thick, knotty, creeping roots, crowned with long, broad, arundinaceous leaves, ending in points, and upright stalks, half a yard high, terminated by bunches of monopetalous, ringent, five-parted flowers. The root of the galanga is used by the Indians to extract the virus communicated by their poisoned arrows: whence it has derived its name. The arundinacea, or starch plant, rises to two feet, has broad pointed leaves, small white flowers, and one seed. It is cultivated in gardens and in provision grounds in the West Indies; and the starch is obtained from it by the following process. The roots when a year old are dug up, well washed in water, and then beaten in wooden mortars to a pulp. This is thrown into a tub of clean water. The whole is then well stirred, and the fibrous part wrung out by the hands, and thrown away. The milky liquor being passed through a hair-sieve, or coarse cloth, is suffered to settle, and the clear water is drained off. At the bottom of the vessel is a white mass, which is again mixed with clean water, and drained: lastly, the mass is dried on sheets in the sun, and is pure starch.

MARBLE, in natural history, a genus of fossils, composed chiefly of lime; being bright and beautiful stones, moderately hard not giving fire with steel, fermenting with, and soluble in, acid menstrua, and calcining in a slight fire. It is of so hard, compact, and fine a texture as readily to take a fine polish, and is much used in ornaments of buildings, as columns, statues, altars, tombs, chimney-pieces, tables, and the like. There are many different kinds of marble. Some are of one simple colour, as white or black; others variegated with stains, clouds, waves, and veins: but all opaque, excepting the white, which, cut into thin pieces, becomes transparent. Marble is found in considerable quantities, in most of the mountainous parts of Europe. Derbyshire abounds in this article. Near Kemlyn Bay, in the island of Anglesea, there is a quarry of beautiful marble, called Verde di Corsica, being common to this place, some parts of Italy, and Corsica. Its colours are green, black, white, and dull purple, irregularly disposed. Italy is that part of Europe which produces the most valuable marble, and in which its exportation makes a considerable branch of foreign commerce. The black and the milk-white marble, coming from Carara, a town in the duchy of Massa, are particularly esteemed.

Marble, *polishing of*, is performed by first rubbing it well with a free stone, or sand, till the strokes of the axe are worn off, then with pumice-stone, and afterwards with emery.

MARBLING, in general, the painting any thing with veins and clouds, so as to represent those of marble. Marbling of books or paper is performed thus: Dissolve four ounces of gum-arabic into two quarts of rain water; then provide several colours mixed with water in pots or shells, and with pencils peculiar to each colour, sprinkle them by way of intermixture upon the gum-water, which must be put in a trough, or some broad vessel; then with a stick curl them, or draw them out in streaks, to as much variety as may be done. Having done this, hold your book or books close together, and only dip the edges in, on the top of the water and colours, very lightly; then take them off, and the plain impression of the colours in mixture will be upon the leaves.

MARCGRAVIA, a genus of the polyandria monogynia class of plants, the corolla whereof consists of a single petal, of a conico-oval figure; and its fruit is a globose berry, with a single cell, containing a great number of very small seeds. There is one species, a shrub of the West Indies.

MARE. See Equus.

MARINE a general name for the navy of a kingdom or state; as also the whole economy of naval affairs, or whatever respects the building, rigging, arming, equipping, navigating, and fighting ships. It comprehends likewise the government of naval armaments, and the state of all the persons employed therein, whether civil or military.

Marine *acid*. See Muriatic *acid*.

Marine-*chair*, a machine invented for viewing the satellites of Jupiter at sea, and thereby determining the longitude of their eclipses.

Marine *remains*, a term used to express the shells of sea-fishes, and parts of crustaceous and other sea-animals, found in digging at great depths in the earth, or on the tops of high mountains. Being found in these situations, is an evident and unquestionable proof of the sea having been once there, since it must have covered those places where it has left its productions.

Mariner's *compass*. See Magnetism.

MARINES, a body of soldiers raised for the sea service, and trained to fight either in a naval engagement, or in an action at shore. The direction of this body is vested in the Lords Commissioners of the Admiralty. It is stationed in three divisions, o at Chatham, one at Portsmouth, and another at Plymouth.

MARITIME, something relating to, or bounded by the sea; thus, a maritime province, or country, is one bounded by the sea; and a maritime kingdom or state is one that makes a considerable figure, or is very powerful at sea. Hence, by maritime powers, among the European states, are understood Great Britain and Holland.

MARK, or Marc, denotes a weight used in several states of Europe, and for several commodities, especially gold and silver. In France, the mark is divided into 8 *oz.* or 64 drachms, 92 derniers or penny weights, or 160 esterlines. or 300 mailles, or 640 felins, or 4608 grains. In Holland the mark-weight is also called troy-weight, and is equal to that of France. When gold and silver are sold by the mark, it is divided into 24 carats.

Mark is also used for a money of account The English mark is two-thirds of a pound sterling. or 13*s.* 1*d.* and the Scotch mark is of equal value in Scotch money of account. The mark-lubs, used at Hamburgh as a money of account, are equal to one-third of the rix dollar; each mark is divided into 16 sols-lubs. Mark is also a copper and silver coin in Sweden.

MARKET. A market is less than a fair, and is commonly held once or twice a week. According to Bracton, one market ought to be distant from all others at least six miles and a half and a third of a half: but no market is to be kept within seven miles of the city of London; but all butchers, victuallers, &c. may hire stalls and standings in the flesh-markets there, and sell meat and other provisions, four days in a week. Every person who has a market is entitled to receive toll for the things sold in it. In London, every shop in which goods are exposed publicly to sale, is market overt for such things only as the owner professes to trade in: though if the sale is in a warehouse, and not publicly in the shop, the property is not altered. If a man buy his own goods in a market, the contract shall not bind him unless the property had been previously altered by a former sale.

MARLE. A mixture of carbonat of lime and clay, in which the carbonat considerably exceeds the other ingredient, is called marle. Its structure is earthy. Opaque, sometimes in powder. Specific gravity from 1.6 to 2.877. Colour usually grey, often tinged with other colours. Effervesces with acids. Some marles crumble into powder when exposed to the air; others retain their hardness for many years. Marles may be divided into two varieties: 1. Those which contain more silica than alumina. 2. Those which contain more alumina than silica. Mr. Kirwan has called the first of these siliceous, the second argillaceous marles. Attention should be paid to this distinction when marles are used as a manure.

Marle, *bituminous*, is found in different parts of Germany. Colour greyish or brownish-black. Found massive. Shistose. Plates flat or waved. Opaque. Feels soft. Easily broken. Moderately heavy. Effervesces with acids. Burns before the blowpipe, leaving black scoriæ.

MARLINS, in artillery, are tarred white skains, or long wreaths or lines of untwisted hemp, dipped in pitch or tar, with which cables and other ropes are wrapped round, to prevent their fretting and rubbing in the blocks or pulleys through which they pass.

MARMOTTE. See Mus.

MARQUE. See Letters *of Marque*.

MARQUETRY, or *inlaid work*, is a curious work composed of several fine hard pieces of wood, of various colours fastened in thin slices on a ground, and sometimes enriched with other matters, as silver, brass, tortoise-shell, and ivory. The ground on which the pieces are to be arranged and glued is usually of well-dried oak or deal; and is composed of several pieces glued together, to prevent its warping The wood to be used in marquetry is reduced into leaves of the thickness of a line, or the 12th part of an inch, and is either of its natural colour or stained, or made black to form the shades by other methods; this some perform by putting it in sand heated very hot over the fire; others by steeping it in lime-water and sublimate; and others in oil of sulphur The wood being of the proper colours, the contours of the pieces are formed according to the parts of the design they are to represent: this is the most difficult part of marquetry, and that which requires the most patience and attention. The two chief instruments used in this work are a saw and a wooden vice, which has one of its chaps fixed, and the other moveable; which is open and shut by the foot, by means of a cord fastened to a treadle.

MARQUIS, a title of honour, next in dignity to that of duke, first given to those who commanded the marches, that is, the borders and frontiers of countries.

Marquises were not known in England till the reign of king Richard II. and the year 1337.

MARRIAGE, a contract, both civil and religious, between a man and a woman. Taking marriage in the light of a civil contract, the law treats it as it does all other contracts: allowing it to be good and valid in all cases where the parties at the time of making it, were, in the first place, willing to contract; secondly, able to contract; and, lastly, actually did contract in the proper forms and solemnities required by law.

By several statutes a penalty of 100*l.* is inflicted for marrying any persons without banns or licence. But by 25 G. II, c. 33, if any person shall solemnize matrimony without banns or licence obtained from some persons having authority to grant the same, or in any other place than a church or chapel where banns have been usually published, unless by special licence from the archbishop of Canterbury, he shall be guilty of felony, and transported for 14 years, and the marriage shall be void.

MARROW. See ANATOMY.

MARRUBIUM, *white horehound*, a genus of the gymnospermia order, in the didynamia class of plants, and in the natural method ranking under the 42d order, verticillatæ. The calyx is salver-shaped, rigid, and tenstriated; the upper lip of the corolla bifid, linear, and straight. There are 11 species, the most remarkable of which is the vulgare, a native of Britain, growing naturally in waste places, and by way-sides near towns and villages, but not common. It has a strong and somewhat musky smell, and bitter taste.

MARS, in astronomy, one of the superior planets, moving round the sun in an orbit between those of the earth and Jupiter.

MARSHAL, in its primary signification, means an officer who has the command or care of horses; but it is now applied to officers who have very different employments, as earl-marshal, knight-marshal, or marshal of the king's house, &c.

MARSHAL *of the king's bench*, an officer who has the custody of the king's bench prison in Southwark. This officer is obliged to give his attendance, and to take into his custody all persons committed by that court.

MARSHAL *of the exchequer*, an officer to whom that court commits the king's debtors.

MARSHALLEA, a genus of the class and order syngenesia polygamia æqualis, little known.

MARSHALLING a coat in heraldry, is the disposal of several coats of arms belonging to distinct families, in one and the same escutcheon or shield, together with their ornaments, parts, and appurtenances.

MARSHALSEA-*court*, is a court of record, originally instituted to hear and determine causes between the servants of the king's household and others within the verge of the court, and has jurisdiction of things within the verge of the court, and of pleas of trespass, where either party is of the king's family; and of all other actions personal, wherein both parties are the king's servants; but the court has also power to try all personal actions, as debt, trespass, slander, trover, action on the case, &c. between party and party, the liberty whereof extends 12 miles about Whitehall. The judges of this court are the steward of the king's household, and high-martial for the time being; the steward of the court, or his deputy, is generally an eminent counsel. If a cause of importance is brought in this court it is generally removed into the court of king's bench or common pleas by a habeas corpus cum causa.

MARSILEA, a genus of the cryptogamia class of plants, without any corolla or cup; the antheræ are four, and placed on an obtusely conic-body; the fruit is of a roundish figure, consisting of four cells, in each of which are contained several roundish seeds. There are three species.

MARTIAL LAW, is the law of war, which entirely depends on the arbitrary power of the prince, or of those to whom he has delegated it. For though the king can make no laws in time of peace without the consent of parliament, yet in time of war he uses an absolute power over the army.

MARTIN. See HIRUNDO and MUSTELA.

MARTLETS, in heraldry, little birds represented without feet, and used as a mark of distinction for younger brothers.

MARTNETS, in a ship, small lines fastened to the leach of a sail, reeved through a block on the topmast-head, and coming down by the mast to the deck.

MARTYNIA, a genus of the angiospermia order, in the didynamia class of plants, and in the natural method ranking under the 10th order, personatæ. There are 60 species, tender, herbaceous, flowery plants of South America.

MARYGOLD. See CALENDULE; and for MARSH-MARYGOLD, see CALTHA.

MASON, a person employed under the direction of an architect in the raising of a stone building. The chief business of a mason is to make the mortar; raise the walls from the foundation to the top, with the necessary retreats and perpendiculars; to form the vaults, and employ the stones as delivered to him. When the stones are large, the business of hewing or cutting them belongs to the stone-cutters, though these are frequently confounded with masons: the ornaments of sculpture are performed by carvers in stones or sculptors. The tools or implements principally used by them are the square, level, plumb-line, bevel, compass, hammer, chissel, mallet, saw, trowel, &c. Besides the common instruments used in the hand, they have likewise machines for raising of great burdens, and the conducting of large stones, the principal of which are the lever, pulley, wheel and axis, crane, &c.

MASONS, *free and accepted*, a very ancient society or body of men, so called, either from some extraordinary knowledge of masonry which they are supposed to be masters of, or because the first founders of the society were persons of that profession. These are now very considerable, both for number and character, being found in every country in Europe, and consisting principally of persons of merit and consideration. As to antiquity, they lay claim to a standing of some thousand years.

MASONRY, in general, a branch of architecture, consisting in the art of hewing or squaring stones, and cutting them level or perpendicular, for the uses of building; but in a more limited sense, masonry is the art of assembling and joining stones together with mortar.

MASSETER, in anatomy, a muscle which has its origin in the lower and interior part of

the jugum, and its end at the external superficies of the angle of the jaw.

MAST, a long round piece of timber, elevated perpendicularly upon the keel of a ship, upon which are attached the yards, the sails, and the rigging, in order to their receiving the wind necessary for navigation.

MASTER *of arts*, is the first degree taken up in foreign universities, and for the most part in those of Scotland, but the second in Oxford and Cambridge; candidates not being admitted to it till they have studied seven years in the university.

Master *in chancery*. The masters in chancery are assistants to the Lord Chancellor and master of the Rolls; of these there are some ordinary, and some extraordinary: the masters in ordinary are twelve in number, some of whom sit in court every day during the term, and have referred to them interlocutory orders for stating accounts, and computing damages and the like; and they also administer oaths, take affidavits, and acknowledgments of deeds and recognizances. The Masters-extraordinary are appointed to act in the country, in several counties of England, beyond ten miles distant from London.

Master *of the faculties*, an officer under the archbishop of Canterbury, who grants licences and dispensations.

Master *of the horse*, a great officer of the crown, who orders all matters relating to the king's stables, races, breed of horses, and commands the equerries and all the other officers and tradesmen employed in the king's stables.

Master *of the ordnance*, a great officer, who has the chief command of the king's ordnance and artillery.

Master *of the rolls*, is an assistant to the Lord Chancellor of England in the high court of chancery; and in his absence hears causes there, and gives orders.

Master *of a ship*, the same with captain in a merchantman; but in a king's ship he is an officer who inspects the provisions and stores, and acquaints the captain with what is not good, takes particular care of the rigging and of the ballast, and gives directions for stowing the hold; he navigates the ship under the directions of his superior officer.

Master *at arms*, in a king's ship, an officer who daily, by turns, as the captain appoints, is to exercise the petty officers and ship's company; to place and relieve sentinels; to see the candles and fire put out according to the captain's orders; to take care the small arms are kept in good order, and to observe the directions of the lieutenant at arms.

Master *of the Temple*, since the dissolution of the order of the Templars, the spiritual guide and pastor of the temple is so called, which was the denomination of the founder and his successors.

Master and **servant**. In London and other places the mode of hiring is by what is commonly called a month's warning, or a month's wages: that is, the parties agree to separate on either of them giving to the other a month's notice for that purpose; or in lieu thereof, the party requiring the separation to pay, or give up, a month's wages. But if the hiring of a servant is general, without any particular time specified, it will be construed to be a hiring for a year certain; and in this case if the servant depart before the year, he forfeits all his wages. And where a servant is hired for one year certain, and so from year to year as long as both parties shall agree, and the servant enters upon a second year, he must serve out that year, and is not merely a servant at will after the first year. If a woman servant marries she must nevertheless serve out her term.

If a servant be disabled in his master's service by an injury received through another's default, the master may recover damages for loss of his service. And a master may not only maintain an action against any one who entices away a servant, but also against the servant: and if without any enticement a servant leaves his master without just cause, an action will lie against another who retains him with a knowledge of such departure.

A master has a just right to expect and exact fidelity and obedience in all his lawful commands; and to enforce this he may correct his servant in a reasonable manner.

In defence of his master, a servant may justify assaulting another; and though death should ensue it is not murder, in case of any unlawful attack upon his master's person or property.

Acts of the servant are, in many instances, deemed acts of the master; for as it is by indulgence of the law that he can delegate the power of acting for him to another, it is just he should answer for such substitute, and that his acts being pursuant to the authority given him, should be deemed the acts of his master. If a servant commit an act of trespass by command or encouragement of his master, the master will be answerable; but in so doing his servant is not excused, as he is bound to obey the master in such things only as are honest and lawful.

If a servant of an innkeeper robs his master's guest, the master is bound to make good the loss. Also, if a waiter at an inn sells a man bad wine, by which his health is impaired an action will be against the master; for his permitting him to sell it to any person is deemed an implied general command. In like manner if a servant is frequently permitted to do a thing by the tacit consent of his master, the master will be liable, as such permission is equivalent to a general command.

If a servant be usually sent upon trust with any tradesman, and he take goods in the name of his master upon his own account, the master must pay for them: and so likewise if he be sent somtimes on trust, and other times with money; for it is not possible for the tradesman to know when he comes by the order of his master, and when by his own authority. But if a man usually deals with his tradesmen himself, or constantly pays them ready money, he is not answerable for what his servant may take up in his name; for in this case there is not, as in the other, any implied order to trust him.

MASTIC, a resinous substance in the form of tears, of a very pale yellow colour, and farinaceous appearance, having little smell, and a bitter astringent taste. It flows naturally from the tree, but its produce is accelerated by incisions. The lesser turpentine tree and the lentiscus afford the mastic of commerce No

volatile oil is obtained from this substance when distilled with water. Pure alcohol and oil of turpentine dissolve it; water scarcely acts upon it; though by mastication it becomes soft and tough, like wax. When chewed a little while, however, it is white, opaque, and brittle, so as not to be softened again by chewing. The part insoluble in alcohol much resembles in its properties caoutchouc. It is used in fumigations, in the composition of varnishes, and is supposed to strengthen the gums.

MASTICATION, in medicine, the action of chewing, or of agitating the solid parts of our food between the teeth, by means of the motion of the jaws, the tongue, and the lips, whereby it is broken into small pieces, impregnated with saliva, and so fitted for deglutition and a more easy digestion.

MASTOIDES. See ANATOMY.

MATCH, a kind of rope slightly twisted, and prepared to retain fire for the uses of artillery, mines, fireworks, &c. It is made of hempen tow, spun on the wheel like cord, but very slack.

MATCH, *quick*, used in artillery, is made of three cotton strands drawn into lengths, and put into a kettle just covered with white-wine vinegar, and then a quantity of saltpetre and mealed powder is put into it, and boiled till well mixed.

MATERIA *Medica*, may be defined to be that branch of the subject of medicine which treats of the particular substances of which medicine in general is composed. The term however has by some been applied not merely to medicine, but to every thing relating to food and drink: but this extension of the application of the term seems to be incorrect; as there is certainly room for a distinction between dietetics, and the cure of diseases. The Materia Medica being so intimately connected with medicine itself, how proper soever it may be to treat of them separately where there is ample scope for it, we presume the generality of our readers will excuse our not giving them a view of the subject which must, from the limits to which our work is confined, be necessarily imperfect. And [illegible] same remark will equally apply to the subject of pharmacy, that proportion of [illegible] page [illegible] for topics of this nature shall be devoted to a brief view of the subject of medicine, which see.

MATHEMATICAL INSTRUMENTS, this term includes all instruments whatever that are used in the practical department of every branch of the mathematics; but is most commonly used to denote those sets of instruments usually sold in cases, and made on a portable plan, so as to fold up into a small space, and to be carried in the pocket without injury to any part. These cases generally contain two pairs of compasses, a sector, plain, and a diagonal scale, a parallel ruler, protractor, black-lead pencil, and drawing-pens; an instrument for making dotted lines; and a pair of bow compasses for describing very small circles. The principal of these requiring description are the scales and sector, of which some notice will be taken under those words.

MATHEMATICS, from μάθησις, originally signified any discipline or learning; but at present denotes that science which teaches or contemplates whatever is capable of being numbered or measured, in so far [illegible] computable or measurable, and accordingly is subdivided into arithmetic, which has number for its object, and geometry, which treats of magnitude.

Mathematics are commonly distinguished into pure and speculative, which consider quantity abstractedly; and mixed, which treat of magnitude as subsisting in material bodies, and consequently are interwoven every where with physical considerations.

Mixed mathematics are very comprehensive; since to them may be referred astronomy, optics, geography, hydrography, hydrostatics, mechanics, fortification, navigation.

MATRASS. See LABORATORY.

MATRICARIA, *feverfew*, a genus of the polygamia superflua order, in the syngenesia class of plants, and in the natural method ranking under the 49th order, compositæ. The receptacle is naked; there is no pappus; the calyx hemispherical and imbricated, with the marginal leaflets solid, and something sharp. There are eight species, but the only remarkable one is the parthenium or common feverfew, of which there are varieties with double flowers. This plant has received a most extraordinary character in hysteric and other affections of the nerves, as well as for being a carminative or warm stimulating bitter.

MATRICE, or *matrices*, used by the letter-founders. See TYPE.

MATRIX, or *mother earth*, the stone in which metallic ores are found enveloped.

MATROSSES, are soldiers in the train of artillery, who are next to the gunners, and assist them in loading, firing, and spunging the great guns. They carry firelocks, and march along with the store-waggons.

MATT, in a ship, rope-yarn, junk, &c. beaten flat and interwoven; used in order to preserve the yards from galling or rubbing in hoisting or lowering them.

MATTER, in common language, is a term of similar import with *body*, and denotes that which is tangible, visible, and extended; but among philosophers it signifies that substance of which all bodies are composed; and in this sense it is synonymous with the word *element*.

It must be confessed that there [illegible] much difficulty attendant on the investigation of this subject: and although it has called forth the powers of such men as Newton, Berkley, Priestley, and others, we do not seem to be yet in possession of any satisfactory theory of it. The following remarks, which form part of a paper in Tilloch's Philosophical Magazine for November, 1823, appeared to us so truly appropriate, and indicative of an understanding of the subject so superior to any thing with which we had hitherto met, that we could not resist the temptation to lay them before our readers.

Bulk and extension pre-suppose solid elementary particles, of which forms are compounded; for if there be no such primary solid particles, there can be no material solidity whatever, either primary or derived; thus no material bulk or extension,—which is absurd.

A solid or primary particle of matter must be the smallest particle, and can admit of no divisibility; for if it can be divided into parts, it is not a solid or primary or the smallest particle; matter is not therefore infinitely divisible

That original, elementary, or solid particle of matter, which admits of no further division, must be the smallest particle of matter; and to say that there is no such thing as this smallest particle, is the same as to affirm that there are no material forms at all;—because it is to affirm that a whole can exist without the parts necessary to compose it.

From this it follows, that there is but one elementary principle in matter, of which principle the primary particle above mentioned consists,—and that all material subjects are forms compounded by motion arranging and co-arranging this elementary principle in innumerable relations and modes; for if there be primary material particles, these must be innumerable, in order to their entering into and producing the innumerable forms and combinations of forms observable in the material universe. It is, moreover, in accordance with reason and observation, thus to consider the original substantiality of matter, whence arises our idea of a simple or primary particle of material substance, called an atom; a congregation of which atoms, by modes of motion, furnishes the idea of natural compounds, or material subjects as they exist in nature, in all their varieties; for as it is evident that modes of motion produce changes in material subjects by transforming them into other material subjects of a totally different form and quality, so analogy points to the conclusion,—that all differences in material subjects, as they exist in nature, are effects of motion disposing primary particles into forms, and then operating successive and various combinations of those forms; and thus, that what is called chemical action, is, when considered in its origin, nothing more than an effect of motion in the more refined and subtle order of substances;—decomposition being effected by opposing forces, composition by attractive forces: and thus also, chemical action, like that which is called mechanical, is resolvable into an effect of motion.

The primary particles of matter, or the substances of which the material universe compounded, appear evidently to be passive, and to be operated upon by active substances of a higher order in creation: and that this is the case, may be concluded from observing the various subjects in nature, to the life of which matter may be said to serve as a fixing or ultimate medium, or instrumental basis; for nothing of life appears to belong inherently to the material substances composing those forms or subjects in nature: on the contrary, the material substances composing such forms, seem to contain and to be operated upon by *interior* forms of life, actuating and disposing them, by modes of motion, into outward forms corresponding to such *interior* or inward forms.

Matter, then, considered in itself, is a passive substance, created as an instrument, or *medium*, for the develepement of an active, living, immaterial substance, in the ultimate or lowest degree of existence, namely, in nature; and this by being made the passive subject into which such living and active subject may enter and manifest itself. Would not such a doctrine, if fully developed, satisfactorily explain some of the first principles of the economy of nature, and prove the presence of the invisible in the visible world, and the order of life therein? Under this view, the natural universe is primarily divisible into two *universals* or principals which enter into every particular of which it is constituted; namely, the active, immaterial, or spiritual; and the passive, material, or natural; the latter being created from, and for the use of the former, and being the last result of the Divine Operation.

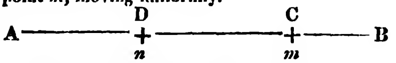
MATTUSCHKÆA, a genus of the tetrandria monogynia class and order. The calyx is four-parted; corolla one-petalled; germ [illegible]rior, four-cleft. There is one species; a herb of Guiana.

MAURITIA, the *gingko*, or *maiden-hair*, a genus of plants belonging to the natural order of almæ. The calyx of the male is monophyllous; the corolla monopetalous, with six stamina. It is a native of Japan, where it is also known by the names of ginan and itsio. It rises with a long, erect, thick, and branched stem, to the size of a walnut-tree.

MAXILLA. See ANATOMY.

MAXIMUM, in mathematics, denotes the greatest quantity attainable in any given case. If a quantity conceived to be generated by motion, increases or decreases, till it arrives at a certain magnitude or motion, and then, on the contrary, grows less or greater, and it be required to determine the said magnitude or position, the question is called a problem de maximis et minimis.

Thus let a point *m* move uniformly in a right line from A towards B, and let another point *n* move after it, with a velocity either increasing or decreasing, but so that it may, at a certain position D, become equal to that of the former point *m*, moving uniformly.



This being premised, let the motion of *n* be first considered as an increasing one; in which case the distance of *n* behind *m* will continually increase, till the two points arrive at the contemporary positions C and D; but afterwards it will again decrease: for the position of *n* till then being slower than at D, it is also slower than that of the preceding point *m* (by the hypothesis), but becoming quicker afterwards than that of *m*, the distance *m n* (as has already been said) will again decrease; and therefore is a maximum, or the greatest of all, when the celerities of the two points are equal to each other.

But if *n* arrives at D with a decreasing celerity, then its motion being first swifter, and afterwards slower, than that of *m*, the distance *m n* will first decrease and then increase, and therefore is a minimum, or the least of all, in the forementioned circumstance. Since then the distance *m n* is a maximum, or a minimum, when the velocities of *m* and *n* are equal, or when that distance increases as fast through the motion of *m* as it decreases by that of *n*, its fluxion at that instant is evidently equal to nothing. Therefore, as the motion of the points *m* and *n* may be conceived such that their distance *m n* may express the measure of any variable quantity whatever, it follows, that the fluxion of any variable quantity whatever, when a maximum or a minimum, is equal to nothing.

The rule therefore to determine any flowing quantity in an equation proposed, to an extreme value, is: having put the equation into fluxions,

Let the fluxion of that quantity, whose extreme value is sought, to be supposed equal to nothing; by which means all those members of the equation in which it is found will vanish, and the remaining ones will give the determination of the maximum or minimum required.

MEAD, an agreeable liquor made of honey and water.

There are many receipts for making mead, of which the following is one of the best. Take four gallons of water, and as much honey as will make it bear an egg; add to this the rind of three lemons, boil it, and scum it well as it rises. Then take it off the fire, and add three lemons cut in pieces; pour it into a clean tub or open vessel, and let it work for three days; then scum it well, and pour off the clear part into a cask, and let it stand open till it ceases to make a hissing noise; then stop it up close, and in three months' time it will be fine and fit for bottling. If you would give it a finer flavour, take cloves, mace, and nutmeg, of each four drams; beat them small, tie the powder in a piece of cloth, and put it into the cask.

MEADOW. See AGRICUTURE.

MEAN, a middle state between two extremes; as a mean motion, mean distance, arithmetical mean, geometrical mean, &c.

MEAN, *arithmetical* is half the sum of the extremes. So 4 is an arithmetical mean between 2 and 6, or between 3 and 5, or between 1 and 7; also an arithmetical mean between a and b is $\frac{a+b}{2}$, or $\frac{1}{2}a + \frac{1}{2}b$.

MEAN, *geometrical*, commonly called a mean proportional, is the square root of the product of the two extremes; so that, to find a mean proportional between two given extremes, multiply these together, and extract the square root of the product.

MEAN, *harmonical*, is double a fourth proportional to the sum of the extremes, and the two extremes, themselves a and b: thus, as $a + b : a :: 2b \cdot \frac{2ab}{a+b} = m$, the harmonical mean between a and b. Or it is the reciprocal of the arithmetical mean between the reciprocals of the given extremes.

MEASLES. See MEDICINE.

MEASURE signifies any given quantity, estimated as one, to which the proportion of other similar quantities may be expressed.

Measure is classed under a variety of heads, of which the following are illustrations.

MEASURE, in geometry, denotes any quantity assumed as one, or unity, to which the ratio of the other homogeneous or similar quantities is expressed.

MEASURE *of a solid*, is a cubic inch, foot, or yard; in other words, a cube, the side of which is an inch, a foot, or a yard.

MEASURE *of a line*, is the extension of a right line at pleasure, which is to be considered as unity; for instance, an inch, a foot, or a yard.

MEASURE *of a figure*, or a surface perfectly level, thence called a plane surface, is a square inch, foot, or yard. This square is termed the measuring unit, because the side is an inch, a foot, a yard, or any other determinate extent.

MEASURE *of a certain portion or quantity of matter*, is its weight.

MEASURE *of a number*, applies thus: 2 is the measure of 4, 3 of 6, &c.; in fact, it is any number which divides without a remainder.

MEASURES in a legal and commercial sense are various, according to the various kinds and dimensions of the things measured.

Long Measures, or Measures of Application.

1. The English and Scotch standards.

The English lineal standard is the yard, containing 3 English feet, equal to 3 Paris feet, 1 inch, and 3-twelfths of an inch, or 7-ninths of a Paris ell.

The Scots elwand is divided into 37 inches. The Scots inch and foot are larger than the English, in the proportion of 180 to 185. The Scots ell, though forbidden by law, is still used for measuring some coarse commodities, and is the foundation of the land-measure of Scotland.

Itinerary measure is the same both in England and Scotland. The length of the chain is 4 poles, or 22 yards; 80 chains make a mile.

ENGLISH MEASURES.

	Inches.
A foot is	12
A yard	36
A pole, or rod	198
A furlong	7920
A mile	63360
A link	7.92
A chain	792
A nail of cloth	2¼
A quarter	9
A yard	36
An ell	45
A hand	4
	Square yards.
An acre	4840

The wine gallon is fixed at 231 cubic inches by an act passed in the reign of Queen Anne, consequently,

	Cubic inches.
A pint is	28.875
A quart	57.75
A barrel	7276.5
A hogshead	14553.
A pint of country ale, or beer measure, is	35 25
A quart	70.5
A gallon	282.
A barrel, beer measure, is	10152.
——— ale ditto	9024.
——— country do	9588.
A hogshead, beer measure is	15228.
——— ale ditto	13336.
——— country ditto	14382.
A pint, dry measure, is	33.6
A quart	67.2
A pottle	134.4
A gallon	268.8
A peck	537.6
A Winchester bushel	2150.42
A heaped bushel is one-third more.	
A quarter	17203.36

A wey, or load, is five quarters; and two loads make a last of wheat.

Sixty pounds is the mean weight of a bushel of wheat, 50 of barley, and 38 of oats.

Thirty-six heaped bushels make a chaldron of coals, which generally weigh about 2988 pounds.

An inch pipe, ten yards in length, contains precisely an ale gallon, weighing 10⅕ pounds.

The ancient standard wine gallon of Guildhall contains 234 cubic inches.

2. The French standard was formerly the aune or ell, containing 3 Paris feet, 7 inches, 8 lines, or 1 yard 2-sevenths English; the Paris foot royal exceeding the English by 68-thousandth parts. This ell is divided two ways, viz. into halves, thirds, sixths, and twelfths; and into quarters, half-quarters, and sixteenths. The French however have formed an entirely new system of weights and measures according to the following table.

Proportions of the measures of each species to its principal measure or unity.	First part of the name which indicates the proportion to the principal measure or unity.	PRINCIPAL MEASURES OR UNITIES.				
		Length.	Capacity.	Weight.	Agrarian.	For firewood.
10,000 1,000 100 10 0 0.1 0.01 0.001	Myria Kilo Hecto Deca Deci Centi Milli	Metre.	Litre.	Gramme	Arc.	Stere.
Proportion of the principal measures between themselves, and the length of the meridian.		10,000,000th part of the dist. from the pole to the equator.	A decimetre cube.	Weight of a centimetre cube of distilled water.	100 Square metres.	One cubic metre.
Value of the principal measure in the ancient French measures.		3 feet 11 lines and ½ nearly.	1 pint and 1/10, or 1 litron and ¼ nearly.	18 grains and 841,000 parts.	2 square perches des eaux et forêt.	1 demi-voie or ¼ of a cord des eaux et forêt.
Value in English measures.		Inches 39.383.	61.083 inches, which is more than the wine and less than the beer quart.	22.966 grains.	11.968 square yards.	

	English Inches.
Millometre	.03937
Centimetre	.39371
Decimetre	3.93710
Metre	39.37100
Decametre	393.71000
Hecatometre	3937.10000
Chiliometre	39371.00000
Myriometre	393710.00000

The metre is 1.09364 yards, or nearly 1 yard 1⅓ nail, or 443,2959 lines French, or .513074 toises.

A decametre is 10 yards, 1 foot, 9.7 inches.

A hecatometre, 109 yards, 1 foot, 1 inch.

A chiliometre, 4 furlongs, 213 yards, 1 foot 10.2 inches.

A micrometre, 6 miles, 1 furlong, 156 yards, 6 inches.

Eight chiliometres are nearly five miles.

An inch is .0254 metre; 2441 inches, 62 metres; 1000 feet, nearly 305 metres.

An are, a square decametre, is 3.95 perches.

A hecatre, 2 acres, 1 rood, 35.4 perches.

	ches English.
Millilitre	.06103
Centilitre	.61028
Decilitre	6.10280
Litre, a cubic decimitre	61.02800
Decalitre	610.28000
Hecatolitre	6102.80000
Chiliolitre	61028.00000
Myriolitre	610280.00000

Two and one-eighth wine pints are about a litre; 3 wine pints are nearly 14 decilitres; a chiliolitre is one tun, 12.75 wine gallons.

3.5317 cubic feet make a decistere, a measure for firewood.

A stere, a cubic metre, .35.3171. A Paris foot is equal to 12.785 inches.

3. The standard in Holland, Flanders, Sweden, a good part of Germany, many of the Hanse towns, as Dantzic and Hamburgh, and at Geneva, Frankfort, &c. is likewise the ell; but the ell in all these places differs from the Paris ell. In Holland it contains one Paris foot 11 lines, or 4-sevenths of the Paris ell. The Flanders ell contains 2 feet 1 inch, 5 lines, and half a line, or 7-twelfths of the Paris ell. The ell of Germany, Brabant, &c. is equal to that of Flanders

4. The Italian measure is the bracchio, brace, or fathom. This is used in the states of Modena, Venice, Florence, Lucca, Milan, Mantua, Bologna, &c. but is of different lengths. At Venice it contains 1 Paris foot, 11 inches, 3 lines, or 8-fifteenths of the Paris ell. At Bologna, Modena, and Mantua, the brace is the same as at Venice. At Lucca it contains 1 Paris foot, 9 inches, 10 lines, or half a Paris ell. At Florence it contains 1 foot, 9 inches, four lines, or 49-hundredths of a Paris ell. At Milan, the brace for measuring of silks is one Paris foot, 7 inches, 4 lines, or 4-ninths of a Paris ell; that for woollen cloths is the same with the ell of Holland. Lastly, at Bergama the brace is 1 foot, 7 inches, 6 lines, or 5-ninths of a Paris ell. The usual measure at Naples, however, is the canna, containing 6 feet, 10 inches, and 2 lines, or 1 Paris ell and 15-seventeenths.

5. The Spanish measure is the vara or yard, in some places called the barra: containing 17 twenty-fourths of the Paris ell. But the measure in Castile and Valencia is the pan, span, or palm; which is used, together with the canna, at Genoa. In Arragon, the vara is equal to a Paris ell and a half, or 5 feet, 5 inches, 6 lines.

6. The Portuguese measure is the cavedos, containing 2 feet, 11 lines, or four sevenths of a Paris ell; and the vara, 106 whereof make 100 Paris ell.

7. The Piedmontese measure is the ras, containing 1 Paris foot, 9 inches, 10 lines, or half a Paris ell. In Sicily, their measure is the canna, the same with that of Naples.

8. The Muscovite measures are the cubit, equal to 1 Paris foot, 4 inches, 2 lines; and the archin, two whereof are equal to three cubits.

9. The Turkish and Levant measures are the picq. containing 2 feet, 2 inches, and 2 lines, or three-fifths of the Paris ell. The Chinese measure is the cobre. ten whereof are equal to three Paris ells. In Persia, and some parts of the Indies, the gueze, of which there are two kinds; the royal gueze, called also the gueze monkelser, containing 2 Paris feet, 10 inches, 11 lines, or four-fifths of the Paris ell; and the shorter gueze, called simply gueze, only two-thirds of the former. At Goa and Ormuz, the measure is the vara, the same with that of the Portuguese, having been introduced by them. In Pegu, and some other parts of the Indies, the cando, or candi, equal to the ell of Venice. At Goa, and other parts, they use a larger cando, equal to 17 Dutch ells, exceeding that of Babel and Balsora by $\frac{7}{8}$ per centum, and the vara by 6½. In Siam, they use the ken, short of three Paris feet by one inch. The ken contains two soks, the sok two keubs, the kube 12 nious or inches, the niou to be equal to eight grains of rice, *i. e.* to be about nine lines.

English Measures of Length.

	Barley-corns	Inch	Palm	Span	Foot	Cubit	Yard	Pace	Fathom	Pole	Furlong
Inch	3										
Palm	9	3									
Span	27	9	3								
Foot	36	12	4	1⅓							
Cubit	54	18	6	2	1½						
Yard	108	36	12	4	3	2					
Pace	180	60	20	6⅔	5	3⅓					
Fathom	216	72	24	8	6	4		1⅕			
Pole	594	198	66	22	16½	11	5½	3$\frac{3}{10}$			
Furlong	23760	7920	2640	880	660	440	220	132	110	40	
Mile	190080	63360	21120	7040	5280	3520	1760	1056	880	390	8

Scripture Measures of Length reduced to English.

								Eng. ft.	Inch dec
Digit								0	0.912
4	Palm							0	36.48
12	3	Span						0	10.944
24	6	2	Cubit					1	9.888
96	24	8	4	Fathom				7	3.552
144	36	12	6	1½	Ezekiel's reed			10	11.328
192	48	16	8	2	1¾	Arabian pole		14	7.104
1920	400	160	80	20	13½	10	Schœnus, or measuring line	145	11.04

The longer Scripture Measures.

						miles.	English paces.	feet.
Cubit						0	0	1.824
400	Stadium					0	145	4.6
2000	5	Sab. day's journey				0	729	3.000
4000	10	2	Eastern mile			1	403	1.000
12000	30	6	3	Parasang		4	153	3.000
96000	240	48	24	8	A day's journey	33	172	4.000

Roman Measures of Length reduced to English.

										English paces.	feet.	dec.
Digitus transversus										0	0	0.725¼
1⅓	Uncia									0	0	0.967
4	3	Palmus minor								0	0	2.901
16	12	4	Pes							0	0	11.604
20	15	5	1¼	Palmipes						0	1	2.505
24	18	6	1½	1⅕	Cubitus					0	1	5.406
40	30	10	2½	2	1⅔	Gradus				0	2	5.01
80	60	20	5	4	3⅓	2	Passus			0	4	1
10000	7500	2500	625	500	41	250	125	Stadim		120	4	4.5
80000	60000	20000	5000	4000	3333⅓	2000	1000	8	Milliare	967	0	0

English square or superficial measures are raised from the yard of 36 inches multiplied into itself, and thus producing 1296 square inches in the square yard: the divisions of this are square feet and inches; and the multiples, poles, roods, and acres, as in the following table:

English Square-Measures.

Inches						
144	Foot					
1296	9	Yard				
3600	25	$2\frac{7}{9}$	Pace			
39204	272¼	30¼	10.89	Pole		
1568160	10890	1210	$435.6\frac{7}{9}$	40	Rd.	
6272640	43560	4840	1743.6	160	4	Ac

Cubical MEASURES *or Measures of capacity for liquids.*—The English measures were originally raised from troy-weight, it being enacted by several statutes that eight pounds troy of wheat, gathered from the middle of the ear, and well dried, should weigh a gallon of wine-measure, the divisions and multiples, of which were to form the other measures: it was also ordered, that there should be but one liquid measure in the kingdom: yet custom has prevailed, and there having been introduced a new weight, viz. the avoirdupois, we have now a second standard gallon adjusted thereto, and therefore exceeding the former in the proportion of the avoirdupois weight to troy-weight. From this latter standard are raised two several measures, the one for ale, the other for beer.

MEASURE *for Horses*, is the hand, which, by statute, contains four inches.

MEASURE is also used to signify the cadence and time observed in poetry, dancing, and music, to render them regular and agreeable. See METRE.

MEASURE, in music, the interval or space of time which the person who beats time takes between the rising and falling of his hand, in order to conduct the movement sometimes quicker and sometimes slower, according to music or subject that is to be sung or played.

MECHANICAL, in mathematics, denotes a construction of some problem, by the assistance of instruments, as the duplicature of the cube and quadrature of the circle, in contradistinction to that which is done in an accurate and geometrical manner.

MECHANICAL *curve*, is a curve, according to Des Cartes, which cannot be defined by any

algebraical equation; and so stands contradistinguished from algebraic or geometrical curves.

MECHANICS, this term which is derived from the Greek μηχανη, a *machine*, is commonly used to denote that branch of natural philosophy which treats of the laws of the equilibrium, and motion of solid bodies; of the forces by which bodies may be made to act on one another; and on the means of employing them so as to overcome other forces that are more powerful.

Sir Isaac Newton distinguishes this science into practical and rational mechanics.

Rational mechanics comprehends the whole theory of motion, shews when the powers or forces are given, how to determine the motions that are produced by them; and conversely when the phenomena of the motions are given, how to trace the powers or forces from which they arise.

Practical mechanics treats of what are denominated the mechanical powers, viz. the lever, balance, axis and wheel, pulley, wedge, screw, and the inclined plane.

The importance of these to society is incalculable: every machine whatever is composed of one or more of them, sometimes of several combined together.

In considering this science, it will be necessary at first to take some things for granted, that are not strictly true; and after the theory is established, to make the proper allowances for them.

1. That a small portion of the earth's surface, which is spherical, may be considered as a plane. 2. That all bodies be supposed to descend in lines parallel to each other; for though all bodies really tend to the centre of the earth, yet the distance from which they fall is comparatively so small, that their inclination towards each other is inconsiderable. 3. That all planes be considered as perfectly smooth; levers to be inflexible, and without thickness or weight; cords perfectly pliable; and machines without friction and inertia.

Three things are always to be considered in treating of mechanical engines; the weight to be raised, the power by which it is to be raised, and the instrument or engine by which this is to be effected.

The mechanical powers are generally reckoned six; the lever, the pulley, the wheel and axis, the inclined plane, the wedge and the screw.

These perhaps may be reduced to two; for the pulley and wheel are only assemblages of levers, and the wedge and screw are inclined planes.

The Lever.

The *lever* is the simplest of all machines; and is only a straight bar of iron, wood, or other material, supported on, and moveable round, a prop called the fulcrum.

In the lever there are three circumstances to be principally attended to: 1. The fulcrum, or prop, by which it is supported, or on which it turns as an axis, or centre of motion: 2. The power to raise and support the weight: 3. The resistance or weight to be raised or sustained.

The points of suspension are those points where the weights really act, or from which they hang freely. The power and the weight are always supposed to act at right angles to the lever, except it is otherwise expressed.

The lever is distinguished into three sorts, according to the different situations of the fulcrum or prop, and the power, with respect to each other. 1. When the prop is placed between the power and the weight. 2. When the prop is at one end of the lever, the power at the other, and the weight between them. 3. When the prop is at one end, the weight at the other, and the power applied between them.

The lever of the first kind is principally used for loosening large stones; or to raise great weights to small heights, in order to get ropes under them, or other means of raising them to still greater heights; it is the most common species of lever.

ABC, plate XXXI. fig. 1, is this lever, in which B is the fulcrum, A the end at which the power is applied, and C the end where the weight acts.

To find when an equilibrium will take place between the power and the weight, in this as well as in every other species of lever, it is necessary to recollect that when the momenta, or quantities of force, in two bodies are equal, they will balance each other. Now let us consider when this will take place in the lever. Suppose the lever AB, fig. 2. to be turned on its axis, or fulcrum, so as to come into the situation DC; as the end D is farthest from the centre of motion, and as it has moved through the arch AD in the same time as the end B moved through the arch BC, it is evident that the velocity of AB must have been greater than that of B. But the momenta being the products of the quantities of matter, multiplied into the velocities, the greater the velocity, the less the quantity of matter need be to get the same product. Therefore, as the velocity of A is the greatest, it will require less matter to produce an equilibrium than B.

Let us next see how much more weight B will require than A to balance it. As the radii of circles are in proportion to their circumferences, they are also proportionate to similar parts of them; therefore, as the arches AD, CB, are similar, the radius or arm DE bears the same proportion to EC that the arch AD bears to CB. But the arches AD and CB represent the velocities of the ends of the lever, because they are the spaces which they moved over in the same time; therefore the arms DE and EC may also represent these velocities. It is evident then, that an equilibrium will take place when the length of the arm AE multiplied into the power A, shall equal EB multiplied into the weight B; and consequently, that the shorter EB is, the greater must be the weight B; that is, the power and the weight must be to each other inversely, as their distances from the fulcrum. Thus suppose AE, the distance of the power from the prop, to be 20 inches, and EB, the distance of the weight from the prop, to be eight inches, also the weight to be raised at B to be five pounds, then the power to be applied at A must be two pounds; because the distance of the weight from the fulcrum eight, multiplied into the weight five, makes 40; therefore 20, the distance of the power from the prop, must be multiplied by two to get an equal product, which will produce an equilibrium.

The second kind of lever, when the weight is between the fulcrum and the power, is repre

sented by fig. 3, in which A is the fulcrum, B the weight, and C the power. The advantage gained by this lever, as in the first, is as great as the distance of the power from the prop exceeds the distance of the weight from it. Thus if the point *a*, on which the power acts, is seven times as far from A as the point *b*, on which the weight acts, then one pound applied at C will raise seven pounds at B. To this kind of lever may be reduced oars, rudders of ships, doors turning upon hinges, cutting-knives which are fixed at the point, &c. If in this lever we suppose the power and the weight to change places, so that the power may be between the weight and the prop, it will become a lever of the third kind; in which, that there may be a balance between the power and the weight, the intensity of the power must exceed the intensity of the weight just as much as the distance of the weight from the prop exceeds the distance of the power. Thus let E, fig. 4, be the prop of the lever EF, and W a weight of one pound, placed three times as far from the prop as the power P acts at F, by the cord going over the fixed pulley D: in this case the power must be equal to three pounds, in order to support the weight of one pound.

To this sort of lever are generally referred the bones of a man's arm; for when he lifts a weight by the hand, the muscle that exerts its force to raise that weight is fixed to the bone about one-tenth part as far below the elbow as the hand is. And the elbow being the centre round which the lower part of the arm turns, the muscle must therefore exert a force ten times as great as the weight that is raised.

What is called the hammer-lever differs in nothing but its form, from a lever of the first kind. Its name is derived from its use, that of drawing a nail out of wood by a hammer.

Let A C B fig. 5, represent a lever of this sort, bent at C, which is its prop, or centre of motion. P is a power acting upon the longer arm AC, at A, by means of the cord DA going over the pulley D; and W is a weight or resistance acting upon the end B of the shorter arm CB. If the power is to the weight as CB is to CA, they are in equilibrio; thus, suppose W to be five pounds, acting at the distance of one foot from the centre of motion C, and P to be one pound, acting at A, five feet from the centre C; the power and weight will just balance each other.

If several levers are combined together in such a manner, as that a weight being appended to the first lever may be supported by a power applied to the last, as in fig 6, (which consists of three levers of the first kind, and is so contrived, that a power applied at the point L, of the lever C, may sustain a weight at the point S of the lever A,) the power must here be to the weight; in a ratio, or proportion, compounded of the several ratios, which those powers that can sustain the weight by the help of each lever, when used singly and apart from the rest, have to the weight. For instance: if the power which can sustain the weight P by the help of the lever A, is to the weight as 1 to 5; and if the power which can sustain the same weight by the lever B alone, is to the weight as 1 to 4; and if the power which could sustain the same weight by the lever C is to the weight as 1 to 5; then the power which will sustain the weight by the help of the three levers joined together, will be to the weight in a proportion consisting of the several proportions multiplied together, of 1 to 5, 1 to 4, and 1 to 5; that is of 1 to 100. For since, in the lever A, a power equal to one-fifth of the weight P pressing down the lever at L, is sufficient to balance the weight; and since it is the same thing whether that power is applied to the lever A at L, or the lever B at S, the point S bearing on the point L; a power equal to one-fifth of the weight P, being applied to the point S of the lever B, will support the weight; but one-fourth of the same power being applied to the point L of the lever B, and pushing the same upward, will as effectually depress the point S of the same lever, as if the whole power was applied at S; consequently, a power equal to one-fourth of one-fifth, that is, one-twentieth of the weight P, being applied to the point L of the lever B, and pushing up the same, will support the weight; in like manner, it matters not whether that force is applied to the point L of the lever B, or to the point S of the lever C, since, if S be raised, L, which rests on it, must be raised also; but one-fifth of the power applied at the point L of the lever C, and pressing it downwards, will as effectually raise the point S of the same lever, as if the whole power were applied at S, and pushed up the same; consequently a power equal to one-fifth of one-twentieth, that is, one-hundredth part of the weight P, being applied to the point L of the lever C, will balance the weight at the point S of the lever A.

The balance, an instrument of very extensive use in comparing the weights of bodies, is a lever of the first kind, whose arms are of equal length. The points from which the weights are suspended being equally distant from the centre of motion, will move with equal velocity; consequently, if equal weights are applied, the momenta will be equal, and the balance will remain in equilibrio.

In order to have a balance as perfect as possible, it is necessary to attend to the following circumstances: 1. The arms of the beam ought to be exactly equal, both as to weight and length. 2. The points from which the scales are suspended should be in a right line, passing through the centre of gravity of the beam; for by this the weights will act directly against each other, and no part of either will be lost on account of any oblique direction. 3. In a balance, therefore, the fulcrum ought always to be placed a little above the centre of gravity. Its vibrations will be quicker, and its horizontal tendency stronger, the lower the centre of gravity, and the less the weight upon the points of suspension. 4. The friction of the beam upon the axis ought to be as little as possible; because should the friction be great, it will require a considerable force to overcome it. The axis of motion should be formed with an edge like a knife and made very hard; these edges are at first made sharp, and then rounded with a fine hone, or piece of buff leather, which causes a sufficient bluntness, or rolling edge. 5. The pivots which form the axis or fulcrum, should be in a straight line, and at right angles to the beam. 6. The arms should be as long as possible, relatively to their thickness, and the purposes for which they are intended; as the longer they are, the

more sensible is the balance. They should also be made as stiff and inflexible as possible; for if the beam is too weak, it will bend, and become untrue. 7. The rings, or the piece on which the axis bears, should be hard and well polished, parallel to each other, and of an oval form, that the axis may always keep its proper bearing, or remain always at the lowest point.

The statera, or Roman steel-yard, is a lever of the first kind, and is used for finding the weights of different bodies, by one single weight placed at different distances from the prop or centre of motion D fig. 7. For the shorter arm DG is of such a weight as exactly to counterpoise the longer arm DX. If this arm is divided into as many equal parts as it will contain, each equal to GD, the single weight P (which we may suppose to be one pound) will serve for weighing any thing as heavy as itself, or as many times heavier as there are divisions in the arm DX, or any quantity between its own weight and that quantity. As for example, if P is one pound and placed at the first division I in the arm DX, it will balance one pound in the scale at W: if it is removed to the second division at 2, it will balance two pounds in the scale; if to the third, three pounds; and so on to the end of the arm DX. If any of these integral divisions be subdivided into as many equal parts as a pound contains ounces, and the weight P be placed at any of these subdivisions, so as to counterpoise what is in the scale, the pounds and odd ounces therein will by that means be ascertained.

The Wheel and Axle.

The wheel and axle is a machine much used, and is made in a variety of forms. It consists of a wheel with an axle fixed to it, so as to turn round with it; the power being applied at the circumference of the wheel, and the weight to be raised is fastened to a rope which coils round the axle.

AB, fig. 9, is a wheel and CD an axle fixed to it, and which moves round with it. If the rope which goes round the wheel is pulled, and the wheel turned once round, it is evident that as much rope will be drawn off as the circumference of the wheel; but while the wheel turns once round, the axle turns once round; and consequently the rope by which the weight is suspended, will wind once round the axis, and the weight will be raised through a space equal to the circumference of the axis.

The velocity of the power, therefore, will be to that of the weight, as the circumference of the wheel to that of the axis.

That the power and the weight may be in equilibrio, therefore, the power must be to the weight as the circumference of the wheel to that of the axis.

It is proved by geometry that the circumferences of different circles bear the same proportion to each other as their respective diameters do; consequently the power is to the weight, as the diameter also of the axis to that of the wheel.

Thus, suppose the diameter of the wheel to be eight inches, and the diameter of the axis to be one inch; then one ounce acting as the power P will balance eight ounces as a weight W; and a small additional force will cause the wheel to turn with its axis, and raise the weight; and for every inch which the weight rises, the power will fall eight inches.

The wheel and axis may be considered as a kind of perpetual lever, of which the fulcrum is the centre of the axis, and the long and short arms are the diameter of the wheel and the diameter of the axis. See fig. 10.

From this it is evident, that the larger the wheel, and the smaller the axis, the stronger is the power of this machine; but then the weight must rise slower in proportion.

A capstan is a cylinder of wood, with holes in it, into which are put bars, or levers, to turn it round; these are like the spokes of a wheel without the rim. Sometimes the axis is turned by a winch fastened to it, which in this respect serves for a wheel; and is more powerful in proportion to the largeness of the circle it describes, compared with the diameter of the axle.

When the parts of the axis differ in thickness, and weights are suspended at the different parts, they may be sustained by one and the same power applied to the circumference of the wheel: provided the product arising from the multiplication of the power into the diameter of the wheel, is equal to the sum of the products arising from the multiplication of the several weights into the diameters of those parts of the axis from which they are suspended.

In considering the theory of the wheel and axle, we have supposed the rope that goes round the axle to have no sensible thickness; but as in practice this cannot be the case, if it is a thick rope, or if there are several folds of it round the axis, you must measure to the middle of the outside rope, to obtain the diameter of the axis, for the distance of the weight from the centre is increased by the coiling up of the rope.

If teeth are cut in the circumference of a wheel, and if they work in the teeth of another wheel of the same size, as fig. 11, it is evident that both the wheels will revolve in the same time; and the weight appended to the axle of the wheel B, will be raised in the same time as if the axle had been fixed to the wheel A. But if the teeth of the second wheel are made to work in teeth made in the axle of the first, as at fig. 12, as every part of the circumference of the second wheel is applied successively to the circumference of the axle of the first, and as the former is much greater than the latter, it is evident that the first wheel must go round as many times more than the second, as the circumference of the second wheel exceeds that of the first axle.

In order to a balance here, the power must be to the weight, as the product of the circumferences, or diameters of the two axles multiplied together, is to the circumferences or diameters of the two wheels. This will become sufficiently clear, if it is considered as a compound lever, which was explained above. Instead of a combination of two wheels, three or four wheels may work in each other, or any number; and by thus increasing the number of wheels, or by proportioning the wheels to the axis, any degree of power may be acquired.

To this sort of engine belong all cranes for raising great weights, and in this case the wheel may have cogs all round it, instead of handles; and a small trundle may be made to

work in the cogs, and be turned by a winch, which will make the power of the engine to exceed the power of the man who works it, as much as the number of revolutions of the winch exceeds those of the axle CD, fig. 9, when multiplied by the excess of the length of the winch above the length of the semidiameter of the axle, added to the semidiameter of the rope K, by which the weight is drawn up. Thus, suppose the diameter of the rope and axle taken together to be 13 inches, and consequently half their diameter to be 6½ inches, so that the weight W will hang at 6½ inches perpendicular distance from below the centre of the axle. Now let us suppose the wheel AB, which is fixed on the axle, to have 80 cogs, and to be turned by means of a winch 6½ inches long, fixed on the axle of a trundle of eight staves, or rounds, working in the cogs of the wheel; here it is plain, that the winch and trundle would make ten revolutions for one of the wheel AB, and its axis CD, on which the rope K winds in raising the weight W: and the winch being no longer than the sum of the semidiameters of the great axle and rope, the trundle could have no more power on the wheel than a man could have by pulling it round by the edge, because the winch would have no greater velocity than the edge of the wheel has, which we here suppose to be ten times as great as the velocity of the rising weight: so that, in this case, the power gained will be as 10 is to 1. But if the length of the winch is 13 inches, the power gained will be as 20 to 1; if 19½ inches (which is long enough for any man to work by,) the power gained will be as 30 to 1; that is, a man could raise 30 times as much by such an engine, as he could do by his natural strength without it, because the velocity of the handle of the winch would be 30 times as great as the velocity of the rising weight; the absolute force of any engine being in the proportion of the velocity of the power, to the velocity of the weight raised by it. But then, just as much power or advantage as is gained by the engine, so much time is lost in working it, which is common in all mechanical cases whatever.

In this sort of machines, it is requisite to have a ratchet wheel on the end of the axle C, with a catch to fall into its teeth; which will at any time support the weight, and keep it from descending, if the person who turns the handle should quit his hold while the weight is rising. By this means, the danger is prevented which might otherwise happen by the running down of the weight when left at liberty.

The Pulley.

The *pulley* is a small wheel turning on an axis, with a drawing-rope passing over it: the small wheel is usually called a sheeve, and is so fixed in a box, or block, as to be moveable round a pin passing through its centre.

Pulleys are of two kinds:—1. Fixed, which do not move out of their places; 2. Moveable, which rise and fall with the weight.

When a pulley is fixed, as fig. 13, two equal weights suspended to the ends of a rope passing over it, will balance each other; for they stretch the rope equally, and if either of them is pulled down through any given space, the other will rise through an equal space in the same time; and consequently, as the velocities of both are equal, they must balance each other. This kind of pulley, therefore, gives no mechanical advantage; so that you can raise no greater weight by it than you could do by your natural strength. Its use consists in changing the direction of the power, and sometimes enabling it to be applied with more convenience. By it a man may raise a weight to any point, without moving from the place he is in; whereas, otherwise, he would have been obliged to ascend with the weight: it also enables several men together to apply their strength to the weight by means of the rope.

The moveable pulley represented at A, fig. 14, plate XXXII. is fixed to the weight W, and rises and falls with it. In comparing this to a lever, the fulcrum must be considered as at A; the weight acts upon the centre, and the power is applied at the extremity of the lever D. The power, therefore, being twice as far from the fulcrum as the weight is, the proportion between the power and weight, in order to balance each other, must be as 1 to 2. Whence it appears, that the use of this pulley doubles the power, and that a man may raise twice as much by it as by his strength alone. Or it may be considered in this way. Every moveable pulley hangs by two ropes equally stretched, and which must, consequently, bear equal parts of the weight: but the rope AB being made fast at B, half the weight is sustained by it; and the other part of the rope, to which the power is applied, has but half the weight to support: consequently the advantage gained by this pulley is as 2 to 1.

When the upper and fixed block contains two pulleys, which only turn upon their axis, and the lower moveable block contains also two, which not only turn on their axis, but rise with the weight F, fig. 15, the advantage gained is as 4 to 1. For each lower pulley will be acted upon by an equal part of the weight; and because in each pulley that moves with the weight, a double increase of power is gained, the force by which F may be sustained, will be equal to half the weight divided by the number of lower pulleys; that is, as twice the number of lower pulleys is to 1, so is the weight suspended to the power.

But if the extremity C fig. 16, is fixed to the lower block, it will sustain half as much as a pulley; consequently here the rule will be, as twice the number of pulleys adding unity is to one, so is the weight to the power.

These rules hold good, whatever may be the number of pulleys in the blocks.

If, instead of one rope going round all the pulleys, the rope belonging to each pulley is made fast at the top, as in fig. 17, a different proportion between the power and the weight will take place. Here it is evident, that each pulley doubles the power; thus, if there are two pulleys, the power will sustain four times the weight.

Fig. 8 is the concentric pulley, invented by Mr. James White. O, R, are two brass blocks, in which grooves are cut; and round these a cord is passed, by which means they answer the purpose of so many distinct pulleys. The advantage gained is found by doubling the number of grooves in the lower block.

It is common to place all the pulleys in each block on the same pin, by the side of each other, as in fig. 18; but the advantage, and

rule for the power, are the same here as in figs. 15 and 16.

A pair of blocks with the rope fastened round it, is commonly called a tackle.

The Inclined Plane.

This mechanical power is of very great use in rolling up heavy bodies, such as casks, wheelbarrows, &c. It is formed by placing boards or earth in a sloping direction.

The force with which a body descends upon an inclined plane, is to the force of its absolute gravity, by which it would descend perpendicularly in free space, as the height of the plane is to its length. For suppose the plane AB, fig. 19, to be parallel to the horizon, the cylinder C will keep at rest on any part of the plane where it is laid. If the plane is placed perpendicularly, as AB, fig. 20, the cylinder C will descend with its whole force of gravity, because the plane contributes nothing to its support or hindrance; and therefore it would require a power equal to its whole weight to keep it from descending.

Let AB, fig. 21, be a plane parallel to the horizon, and AD a plane inclined to it; and suppose the whole length AD to be three times as great as the perpendicular DB. In this case, the cylinder E will be supported upon the plane DA, and kept from rolling, by a power equal to a third part of the weight of the cylinder; therefore a weight may be rolled up this inclined plane by a third part of the power which would be sufficient to draw it up by the side of an upright wall. It must also be evident, that the less the angle of elevation, or the gentler the ascent is, the greater will be the weight which a given power can draw up; for the steeper the inclined plane is, the less does it support of the weight; and the greater the tendency which the weight has to roll, consequently the more difficult for the power to support it: the advantage gained by this mechanical power, therefore, is as great as its length exceeds its perpendicular height. To the inclined plane may be reduced all hatchets, chisels, and other edge-tools.

The Wedge

Is the fifth mechanical power or machine; it may be considered as two equally inclined planes, joined together at their bases: then DG, fig. 22, is the whole thickness of the wedge at its back ABGD, where the power is applied; EF is the depth or height of the wedge; BF the length of one of its sides; and OF is its sharp edge, which is entered into the wood intended to be split, by the force of a hammer or mallet striking perpendicularly on its back. Thus AB, fig. 23, is a wedge driven into the cleft CED of the wood FG.

When the wood does not cleave at any distance before the wedge, there will be an equilibrium between the power impelling the wedge downward, and the resistance of the wood acting against the two sides of the wedge, when the power is to the resistance as half the thickness of the wedge at its back is to the length of either of its sides; because the resistance then acts in a direction perpendicular to the sides of the wedge. But when the resistance on each side acts parallel to the back, the power that balances the resistances on both sides will be, as the length of the whole back of the wedge is to double its perpendicular height.

When the wood cleaves at any distance before the wedge (as it generally does,) the power impelling the wedge will not be to the resistance of the wood as the length on the back of the wedge is to the length of both its sides, but as half the length of the back is to the length of either side of the cleft, estimated from the top or acting part of the wedge. For, if we suppose the wedge to be lengthened down from the top CE, to the bottom of the cleft at D, the same proportion will hold; namely, that the power will be to the resistance as half the length of the back of the wedge is to the length of either of its sides: or, which amounts to the same thing, as the whole length of the back is to the length of both the sides. The wedge is a very great mechanical power, since not only wood, but even rocks, can be split by it; which it would be impossible to effect by the lever, wheel and axle, or pulley; for the force of the blow or stroke, shakes the coherent parts, and thereby makes them separate more easily.

The Screw.

The screw, fig. 24, is the sixth and last mechanical power, but cannot properly be called a simple machine, because it is never used without the application of a lever or winch to assist in turning it; and then it becomes a compound engine of a very great force, either in pressing the parts of bodies closer together or in raising great weights. It may be conceived to be made by cutting a piece of paper, ABC, fig. 25, into the form of an inclined plane, or half wedge; and then wrapping it round a cylinder, fig. 26, the edge of the paper AC will form a spiral line round the cylinder, which will give the thread of the screw. It being evident that the winch must turn the cylinder once round, before the weight of resistance can be moved from one spiral winding to another, therefore, as much as the circumference of a circle described by the handle of the winch is greater than the interval or distance between the spirals, so much is the force of the screw. Thus supposing the distance of the spirals to be half an inch, and the length of the winch twelve inches, the circle described by the handle of the winch where the power acts will be 76 inches nearly, or about 152 half-inches, and consequently 152 times as great as the distance between the spirals: and therefore a power at the handle, the intensity of which is equal to no more than a single pound, will balance 152 pounds acting against the screw; and as much additional force as is sufficient to overcome the friction, will raise the 152 pounds; and the velocity of the power will be to the velocity of the weight, as 152 to 1. Hence it appears, that the longer the winch is, and the nearer the spirals are to one another, so much the greater the force of the screw.

A machine for shewing the force or power of the screw may be contrived in the following manner: Let the wheel C have a screw, fig. 24, on its axis, working in the teeth of the wheel D, which suppose to be 48 in number. It is plain, that for every time the wheel C and screw are turned round by the winch A, the wheel D will be moved one tooth by the screw; and therefore, in 48 revolutions of the winch,

the wheel D will be turned once round. Then, if the circumference of a circle, described by the handle of the winch A, be equal to the circumference of a groove round the wheel D, the velocity of the handle will be 48 times as great as the velocity of any given point in the groove. Consequently, if a line G go round the groove, and have a weight of 48 pounds hung to it, a power equal to 1 pound at the handle will balance and support the weight. To prove this by experiment, let the circumferences of the grooves of the wheels C and D be equal to one another; and then if a weight H, of 1 pound be suspended by a line going round the groove of the wheel C, it will balance a weight of 48 pounds hanging by the line G; and a small addition to the weight H will cause it do descend, and so raise up the other weight.

If a line G, instead of going round the groove of the wheel D, go round its axle I, the power of the machine will be as much increased as the circumference of the groove exceeds the circumference of the axle; which supposing to be six times, then one pound at H will balance six times 48, or 288 pounds, hung to the line on the axle; and hence the power or advantage of this machine will be as 288 to 1. That is, a man who by his natural strength could lift a hundred weight, will be able to raise 288 cwts. by this engine. If a system of pulleys were applied to the cord H, the power would be increased to an amazing degree. When a screw acts in a wheel in this manner, it is called an endless screw. When it is not employed in turning a wheel, it consists of two parts: the first is called the male or outside screw; being cut in such a manner, as to have a prominent part going round the cylinder in a spiral manner, which prominent part is called the thread of the screw, the other part which is called the female, or inside screw, is a solid body, containing a hollow cylinder, whose concave surface is cut in the same manner as the convex surface of the male screw, so that the prominent parts of the one may fit the concave parts of the other.

A very considerable degree of friction always acts against the power in a screw; but this is fully compensated by other advantages; for on this account the screw continues to sustain a weight, even after the power is removed, or ceases to act, and presses upon the body against which it is driven. Hence the screw will sustain very great weights; insomuch that several screws, properly applied, would support a large building, whilst the foundation was mending, or renewed.

Of Compound Machines.

Though it is evident from the principles delivered above, that any one of the mechanical powers is capable of overcoming the greatest possible resistance in theory; yet in practice, if used singly for producing very great effects, they would be frequently so unwieldy and unmanageable, as to render it impossible to apply them. For this reason, it is generally found more advantageous to combine them together; by which means the power is more easily applied, and many other advantages are obtained. In all machines, simple as well as compound, what is gained in power is lost in time. Suppose that a man, by a fixed pulley, raises a beam to the top of a house in two minutes, it is clear that he will be able to raise six beams in twelve minutes, but by means of a tackle with three lower pullies he will raise all at once, with the same ease as he before raised one; but then he will be six times as long about it, that is, twelve minutes: thus the work is performed in the same time, whether the mechanical power is used or not. But the convenience gained by the power is very great; for if the six beams are joined in one, they may be raised by the tackle, though it would be impossible to move them by the unassisted strength of one man.

No real gain of force is, therefore, obtained by mechanical contrivances; on the contrary, from friction, and other causes, force is always lost; but by machines we are able to give a more convenient direction to the moving power, and to apply its action at some distance from the body to be moved, which is a circumstance of great importance. By machines also, we can so modify the energy of the moving power, as to obtain effects which it could not produce without this modification.

In machines composed of several of the mechanical powers, the power will be to the weight, when they are in equilibrio, in a proportion formed by the multiplication of the several proportions which the power bears to the weight in every separate mechanical power of which the machine consists.

In contriving machines, simplicity ought particularly to be attended to; for a complicated machine is not only more expensive, and more apt to be out of order, but there is also a greater degree of friction, in proportion to the number of rubbing parts.

Whatever may be the construction of a machine, its power will always be in proportion to the velocity of the power to the weight; and so that this is obtained in the greatest degree that circumstances will admit, then the fewer parts the better.

It is evident, from the principles already laid down, that the velocity of a wheel is to that of a pinion, or smaller wheel which is driven by it, in proportion to the diameter, circumference or number of teeth in the pinion to that of the wheel.

Hence, if you have any number of wheels acting on so many pinions, you must divide the product of the teeth in the wheels by those in the pinions; and the quotient will give the number of turns of the last pinion in one turn of the first wheel. Thus, if a wheel A, fig. 27, of 48, acts on a pinion B of 8, on whose axis there is a wheel C of 40, driving a pinion D of 6, carrying a wheel E of 36, which moves a pinion F of 6, carrying an index; then the number of turns made by the index will be found in this manner: $\frac{48}{8}\times\frac{40}{6}\times\frac{36}{6}=\frac{60120}{288}=240$, the number of turns which the index will make while the wheel A goes once round.

Any number of teeth on the wheels and pinions having the same ratio, will give the same number of revolutions to an axis: thus, $\frac{64}{10}\times\frac{50}{8}\times\frac{36}{6}=\frac{115200}{480}=240$, as before. It therefore depends upon the skill of the engineer or mechanic, to determine what numbers will best suit his design.

It is evident, that the same motion may be performed, either by one wheel and pinion, or

by many wheels and pinions, provided the number of turns of all the wheels bear the same proportion to all the pinions which that one wheel bears to its pinion.

When a wheel is moved immediately by the power, it is called a leader; and if there is another wheel on the same axis, it is called the follower. Thus A, being moved immediately by the power, is to be considered as a leader, and B as a follower: the wheel C being driven by B, becomes a leader, and D a follower; E, fig. 28, is a leader, and the cylinder F may be considered as a follower.

Sometimes the same wheel acts both as a leader and a follower, as in fig. 29, where B is moved by A, and consequently is a follower, while, as it drives C, it is also a leader. Therefore, as to multiply both the divisors and dividend by the same number does not alter the quotient; in mechanical calculations, every wheel, that is both a leader and a follower, may be entirely omitted.

The power of a machine is not at all altered by the size of the wheels, provided the proportions to each other are the same.

The application of animal strength as a moving power in machinery.

A horse draws with the greatest advantage, when the line of draught is not level with his breast, but inclines upwards, making a small angle with the horizontal plane.

A horse drawing weight over a single pulley, can draw 200lb. for eight hours a day, and walking at the rate of 2½ miles in an hour, which is about 3½ feet in a second, and if the same horse be made to draw 240lb. he can work but six hours a day, and cannot go quite so fast.

When a horse draws in a mill, or gin of any kind, great care should be taken that the horse-walk or circle in which he moves, be large enough in diameter, otherwise the horse cannot exert all his strength; for, in a small circle, the tangent (in which the horse draws) deviates more from the circle in which the horse is obliged to go, than in a larger circle. The horse-walk should not be less than 40 feet in diameter, when there is room for it. In a walk of 19 feet diameter, it has been calculated that a horse loses two-fifths of his strength. The worst way of applying the force of a horse, is to make him carry or draw up hill; for if the hill is steep, three men will do more than a horse. As a horse, from the structure of his body, can exert most strength in drawing almost horizontally in a straight line, a man exerts the least strength that way.

A man turning a horizontal windlass by a handle, or winch, should not have above 30lb. weight acting against him, if he is to work ten hours a day, and raise the weight at the rate of three feet and a half in a second. This supposes, however, that the semidiameter of the windlass is equal to the distance from the centre to the elbow of the handle; for if there is a mechanical advantage, as there usually is, by having the diameter of the axle, on which the rope winds, four or five times less than the diameter of the circle described by the hand, then may the weight (taking in also the resistance, on account of the friction and stiffness of the rope, be four or five times greater than 30lb that is, so much as it rises slower than the hand moves.

MEDAL, denotes a piece of metal in the form of coin, such as was either current money among the ancients, or struck on any particular occasion to preserve the portrait of some great person, or the memory of some illustrious action, to posterity.

As historical documents, medals form the principal evidence we can have of the veracity of old historians. In some few instances they correct the names of sovereigns; and in a great many, illustrate the chronology of reigns. By their assistance, the geographer has sometimes been enabled to determine the situation of a town whose name alone has reached us. To the naturalist they afford the only proofs of the knowledge which the ancients had of certain plants and animals; and they sometimes preserve delineations of buildings for the architect, of which not even a ruin is, at this day, standing. To the connoisseur they are absolutely necessary, as they enable him to appropriate the busts and portraits of antiquity. And the scholar need hardly be reminded that they have contributed in no small degree to the elucidation of obscure passages in ancient authors. The alto-relievo of the Greek coins is one of the best schools of study for the sculptor.

The study of medals, perhaps, is not of very ancient date Petrarch is said to have been one of the first who began to study the medallic science. Alphonso, king of Arragon, formed another collection. And a third was placed by Cosmo de Medici among the curiosities in the Museum at Florence. In this country, though we know of the existence of no cabinet before the time of Camden, it may be supposed that the knowledge of coins and medals was introduced from Italy. The "Britannia" was the first work in which engravings of them were produced: and Speed's Chronicle, which soon followed it, was illustrated with coins from the collection of Sir Robert Cotton. Henry prince of Wales was one of the first who had a *rich* cabinet; and he bequeathed it at his death to Charles. The most considerable of our other early collectors were, archbishop Laud, Lord Arundel, and Mr. Selden. Oliver Cromwell, we are told, had a small collection; and the cabinet of Charles the Second is mentioned by Vaillant.

MEDALLION, or MEDALION a medal of an extraordinary size, supposed to be anciently struck by the emperors for their friends, and for foreign princes and ambassadors; but that the smallness of their number might endanger the loss of the devices they bore, the Romans generally took care to stamp the subject of them upon their ordinary coins. Medallions, in respect of the other coins, were the same as modern medals in respect of modern money; they were exempted from all commerce, and had no other value but what was set upon them by the fancy of the owner.

MEDEOLA, *climbing African asparagus*, a genus of the hexandria trigynia order and class of plants. Natural order, sarmentaceæ. No calyx; cor. sexpartite and revoluted; berry trispermous. The flower has no empalement, three-horned germina terminate the style; and

turn to a roundish trifid berry, with three cells. There are three species.

MEDICAGO, *snail-trefoil*, a genus of the decandria order, in the diadelphia class of plants, and in the natural method ranking under the 32d order, papilionaceæ. There are 11 species, though only five are commonly cultivated in this country. The M. sativa or lucern, has been laterly much recommended as a green fodder for cattle, and has been cultivated by some farmers with success.

MEDICINE, is the art of preserving health, and of curing or alleviating disease. It is the same science in its application to animal, as agriculture to vegetable life. In order to reduce the practice of medicine to something definite, to simplify what was perplexed, and to lay down certain general rules for a more accurate investigation of diseases, physicians in all ages have attempted to arrange these last into a systematized form; and the works which have thus treated of diseases, are entitled Nosologies.

The following are the classes, orders, and genera of Cullen, with the exception of the class locales, which relates to those disorders principally that come under the head of surgery.

Table of Classification.

Class I. Pyrexiæ. A frequent pulse, succeeding to shivering or horror; increased heat; disturbed functions; prostration of strength.

Order I. *Febris.* Pyrexia, independant of local affection as its cause; languor, lassitude, and other signs of debility.

Sect. 1. *Intermittentes.* Fevers arising from the miasma of marshy grounds, with an evident remission, the returning fits being almost always ushered in by horror or trembling. One paroxysm only in the day.

Genera. Tertiana; quartana; quotidiana.

Sect. 2. *Continuæ.* Fevers without intermission, not occasioned by marsh miasma, attended with exacerbations and remissions, though not very perceptible.

Genera. Synocha; typhus; synochus.

Order II. *Phlegmasiæ.* Fever, accompanied by local inflammation or topical pain, lesion, or disturbance of the internal functions; sizy blood.

Genera. Phlogasis ophthalmia; phrenitis; cynanche; pneumonia carditis; peritonitis; gastritis; enteritis; hepatitis; splenitis; nephritis; cystitis; hysteritis; rheumatismus; odontalgia podagra; arthropuosis.

Order III. *Exanthemata.* Contagious diseases, which only affect once during life, commencing with fever, and succeeded by phlogosis or inflammatory eruptions on the skin.

Genera. Erysipelas; pestis; variola; varicella; rubeola muliaria; scarlatina; urticaria; pemphygus; apthæ.

Order IV. *Hemorrhagiæ.* Pyrexia; spontaneous discharge of blood; blood when drawn from a vein of a sizy appearance.

Genera. Epistasis; hemaptisis; hæmarrhois; menarrhagia.

Order V. *Profluviæ.* Pyrexia; inordinate discharge, but not of blood.

Genera. Catarrh; dysenteria

Class II. Neuroses. A lesion of sense and motion, without idiopathic pyrexia or local disorder.

Order I. *Comata.* A diminution of voluntary motion with sleep, or a deprivation of sense.

Genera. Apoplexia; paralysis.

Order II. *Adynamiæ.* Diminished voluntary motion, whether vital or natural.

Genera. Syncope; dyspepsia; hypochondriasis; chlorosis.

Order III. *Spasmi.* Irregular action of the muscular fibre.

Sect. 1. In the animal functions.

Genera. Tetanus; trismus; chorea; raphania; epilepsia.

Sect. 2. In the vital functions.

Genera. Palpitatio; asthma; dyspnæ; pertussis.

Sect. 3. In the natural functions.

Genera. Pyrosis; colica; cholera; diarrhœa; diabetes; hysteria: hydrophobia.

Order VI. *Vesaniæ.* Derangement of judgment, independantly of pyrexia or coma.

Genera. Amextia, melancholia; mania oneirodynia.

Class III. Cachexiæ. A depraved habit of body, without idopathic pyrexia or neurosis.

Order I. *Macores.* A wasting of the whole body.

Genera. Tabes; atrophia.

Order II. *Intumescentiæ.* A swelling of the whole or of the greatest part of the body.

Sect. I. *Adiposæ.* Fatty swellings.

Genus. Polysarcia.

Sect. 2. *Flatulosæ.* Windy swellings.

Genera. Pneumatosis; tympanites; physometra.

Sect. 3. *Hyaropes.* Watery swellings.

Anasarca; hydrocephalus; hydrorachiti hydrothorax; arcites; hydrometra; hydrocele physconia.

Order III. *Impetigines.* Cachexies, chiefly deforming the skin and external parts of the body.

Genera. Scrophula; syphilis; scorbutus elephantiasis; lepra; framneesia; trichoma, icterus.

Class I. Order I.—*Febris.*

Of the Phenomena of Fever.

The person is affected with languor or sense of debility, a sluggishness in motion, and some uneasiness in exerting it, with frequent yawning and stretching. At the same time the face and extremities become pale, the features shrink, the bulk of every external part is diminished, and the skin over the whole body appears constricted as if cold had been applied to it. At the coming on of these symptoms, some coldness of the extremities, though little taken notice of by the patient, may be perceived by another person. At length the patient himself feels a sensation of cold, commonly first in his back, but then passing over his whole body; and now his skin feels warm to another person. The patient's sense of cold increasing, produces a tremor in all his limbs, with frequent successions or rigors in the trunk of the body. When this sense of cold and its effects have continued for some time, they become less

violent, and are alternated with warm flushings. By degrees the cold goes off entirely; and a heat greater than natural prevails and continues over the whole body. With this heat the colour of the skin returns, and a preternatural redness appears especially in the face. Whilst the heat and redness come on, the skin is relaxed and smooth, but for some time continues dry. The features of the face and other parts of the body, recover their usual size, and become even more turgid. When the heat, redness, and turgescence, have increased and continued for some time, a moisture appears on the forehead, and by degrees becomes a sweat, which gradually extends downwards over the whole body. As this sweat continues to flow, the heat of the body abates; the sweat after continuing for some time, gradually ceases, the body returns to its usual temperature, and most of the functions are restored to their ordinary state.

This order is divided into two sections, an intermittent, including tertians, quartans, and quotidians, with the different varieties of these distinct genera; and continued, which include the genera of synocha, or simple inflammatory fever; typhus, putrid, or gaol fever; and synochus, a mixed fever commencing like the first, and terminating like the second. The intermittent family are divided as follows: Fevers arising from the miasm of marshy grounds with an evident remission, the returning fits being almost always ushered in by horror or trembling. One paroxysm only in the day. The continued family are defined thus: fevers without intermission, not occasioned by marsh miasm, attended with exacerbations and remissions, though not very perceptible.

The genera of continued fever, are,

1. *Synocha.* "Great heat, pulse frequent, strong, and hard; high-coloured urine, the functions of the sensorium not much impaired." Such character, however, does not answer to any case of simple fever; it is the definition of what Dr. Brown calls the sthenic, which is opposed to the true febrile state.

2. *Typhus.* "A contagious disease, the heat not much increased, pulse frequent, small and weak; urine little changed, sense much impaired, and the strength greatly diminished."

3. *Synochus.* This is made by Cullen a kind of intermediate disease between synocha and typhus.

Exciting causes of fever. On this subject the most opposite opinions prevail. It is imagined by some, that no case of genuine fever, beyond those ephemeral irritations which are of daily occurrence, can possibly originate without the previous application, either through the medium of the lungs, or the surface of the body, of a certain something generated in the system of another individual in the course of the same disease. Others infer, from the daily observation of febrile diseases where no communication with the sick can be traced or suspected, that although the febrifacient matter just spoken of be in many, it is not in all instances the cause of fever; that cold, damp, heat, putrid exhalations whether animal or vegetable, insufficient ventilation, the depressing passions, &c. are all, either singly or in conjunction, capable, under some circumstances, not merely of predisposing to, but of actually engendering, proper fever. Lastly, there are some who consider contagion, or the generation in fever of specific febrifacient matter, as totally imaginary; and conceive in instances where fever has spread by communication, that either certain undetected conditions in the air, or the confined effluvia of animal excretions accumulated by want of cleanliness and ventilation, with other circumstances, are causes sufficiently adequate to produce the affection, without supposing the agency of a specific and occult power.

"The remote causes of fever," says Dr. Cullen, "are certain sedative powers applied to the nervous system, which diminishing the energy of the brain, thereby produce a debility in the whole of the functions, and particularly in the action of the extreme vessels."

The Treatment of Fever.

In the treatment of fever it is particularly necessary to diminish the cold in the cold stage, the heat in the hot stage, and not to await the senative process of nature, either of dissolving spasm, or of correcting and expelling morbific matter. The various remedies employed for these purposes are, the external and internal use of cold and warm water; refrigerants, sudorifics, opiates, emetics, purgatives.

"The safest and most advantageous time," says Dr. Currie "for using the cold water is, when the exacerbation is at its height, or immediately after its declination has begun; and this has led me almost always to direct it to be employed from six to nine in the evening; but it may be safely used at any time of the day, *when there is no sense of chilliness present, when the heat of the surface is steadily above what is natural, and when there is no general or profuse perspiration.*

"Under these restrictions," our author adds, "the cold effusion may be used at any period of fever; but its effects are more salutary in proportion as it is used early. When employed in the advanced stages of fever, where the heat is reduced and the debility great, some cordial should be given immediately after, and the best is warm wine."

From the urgency however, of the debility, or from the prejudices of the patient or his friends, in some periods of fever, even the application of cold water in the way of ablution may be regarded as too severe. In this case tepid ablution has been made to supply its place and often with propriety and success. The term tepid is applied by Dr. Currie to water, from 87° to 97° of Fahrenheit; from 87° to 75° the water is denominated cool. Cold water may be given internally, and with the utmost freedom, in the hot stage of the febrile paroxysm. Its use, however, requires to be carefully regulated by the same restrictions as in the external application; it must never be given unless the heat of the surface be steadily above the natural standard. Draughts of cold water have been known, when properly administered, to procure a sudden solution of the disease.

Cold air. The extraordinary melioration in the modern practice of medicine, as it relates to the treatment of fever and febrile diseases is not confined to the copious use of effusion and ablution. The terrors of our predecessors in relation likewise to cold air, are fast de

parting; and the importance of its free admission in the apartments of the febrile sufferer especially, comes to be generally acknowledged and applied.

The utility of cold air in fever is referable to two principles: 1st. That of immediately lowering the heat of the surface, and thus taking off the oppression occasioned by such heat: and 2ndly, from affording a larger quantity of oxygen at each inspiration.

The admission of cold air requires to be restricted to the hot stage, and to be limited by the patient's feelings; a current of cold air passing rapidly over the body while in a state of perspiration, may be productive of fatal consequences. Besides, however, the employment of cold water, and the free admission of a cool and pure atmosphere, other agents have been had recourse to, and with considerable effect, in order to abate the inordinate heat of fever. From possessing the faculty of cooling the system, certain medicines have been distinguished by the term refrigerants: refrigerants are principally chosen from the vegetable acids, and the different neutral salts; and so evident is their power in reducing animal temperature, that they have properly been made to constitute a considerable part of regimen in fever.

Of Sudorifics.

Moisture on the surface of the body may be procured by medicines which appear to have a direct power over the cutaneous vessels, or by those whose action seems to be directed primarily to the stomach. These last are principally of the saline class, which are by far the most suitable in the febrile state.

Of Purgatives and Emetics.

Nothing, perhaps, is of greater moment in almost every stage and every kind of fever, than to preserve the whole of the alimentary canal free from accumulations of colluvies, &c. From a deficient attention to this principle, the medical practitioner is in many instances foiled in the treatment of this, and indeed in a variety of other diseases. Viscidities and impurities in the stomach and bowels, are often both the effect and cause of the persistance of the febrile state. In the primary stages of fever, an emetic has been known abruptly to arrest its progress, and the same purpose is sometimes accomplished, especially in ephemeral affections of the febrile kind, by the employment of a brisk purgative. In the more advanced periods however of the disorder, the object of the physician ought to be rather that of keeping the bowels gently open, and this is best effected by saline in place of drastic purgatives; the former of which princpally operate by exciting the exhalants on the internal surface of the intestines to pour out their contents, the latter by stimulating in a forcible manner the intestinal fibre. In intermittent fevers it is generally necessary to evacuate the bowels by more stimulant cathartics, more especially when the cure of these fevers is conducted by the Peruvian bark. If during fever, indicating in its primary stages no particular severity of disease, a rapid change takes place in the feelings and expressions of the invalid; if upon the more ordinary symptoms, suddenly and unexpectedly supervene delirium, prostration of strength, an observable change in the countenance, accompanied by irregular [illegible] partial alternations of heat and cold, without [illegible] intervention of the perspiring state, the patient's life is in considerable danger. The above changes are often indeed preludes to a speedy death.

Weakness, quickness, and irregularity of pulse, delirium, tendency to fainting when in an erect posture, prostration of strength, partial and irregular sweats, difficult respiration and deglutition, starting of the tendons, unusual fœtor in the excretions, great foulness of the tongue and fauces, are all evidences of a fatal tendency in the complaint; in general likewise it may be observed, that in cases where marks of great nervous irritation attend the onset of a fever, even though the disorder may not assume what has erroneously been termed the putrid type, much danger is to be apprehended.

Calculations respecting critical days have been in some measure forced and systematic. It is worthy however of remark, that continued fevers as well as intermittent, in the successive stages of their course, are disposed to assume progressively the quotidian, tertian, and quartan aspect.

Recapitulation of the treatment of Fever.

Treatment of continued fever during the first three or four days. Cold affusion. Water to be impregnated with salt, its application to be confined to the hot stages of the paroxysm. Large draughts of cold water taken under the same limitation. Cold and pure air. Emetics. Purgatives. Antimonia and saline sudorifics.

After the fifth or sixth day. Cold and tepid ablution. Water employed to be impregnated with salt or mixed with vinegar. In the urgency of debility, coldness, or delirium, prediluvium or the warm bath. Bowels to be kept gently but constantly open, by saline or mild purgatives and subacid drinks. While the skin is preserved moist by diaphoretics, give opiates and wine; these last are almost invariably improper when the skin is dry and hot, and the bowels costive. For head-ache and other nervous affections, blisters, æther, camphor. In the last stages, when critical sweats break out, and the powers of life appear to be shrinking from the contest, repeated glasses of port wine with tincture of opium in large quantities. During the whole course of the disease, the apartment to be diligently preserved cool, clean, constantly ventilated, and free from all individuals but those who are necessary attendants on the sick.

Treatment of intermittent fever. Cold affusion immediately upon the full accession of the hot fit. Warm bath, warm spiced wine, during the cold stage of the paroxysm Tincture of opium, either previous to the accession of the cold, or towards the decline of the hot fit. Emetics, immediately preceding the accession of the paroxysm. Calomel purges before the administration of tonics; arsenic, zinc, Peruvian bark, quasia. and if any enlargement of one of the viscera (ague cake) appear, steel. Hope: upon the excitation of hope the power of charms altogether depends; these sometimes succeed in ague, when other remedies are counteracted by the violence of the complaint.

ORDER II.—*Phlegmasiæ*, Inflammations.

When any part of the body has an unusual

heat and redness, with pain and swelling, it is said to be inflamed. To constitute this state of a part, an inordinate action and dilation of vessels have generally been esteemed sufficient.

Sthenic and asthenic inflammation. The disturbance of the system does not correspond more with the magnitude of the local disorder, than with the constitutional character of the individual affected. Of two persons that are the subjects of inflammation, as of the mucous membrane of the nostrils, constituting inflammatory catarrh, or a cold; of the pulmonary vessels, occasioning inflammation of the lungs; or of the joints, forming rheumatism; one shall previously have possessed much constitutional vigour, the other shall have been languid and feeble—the former will have a sthenic, the latter an asthenic disease.

Termination of inflammation. Inflammation is said to be resolved when the natural state and action of parts are renewed without disorganization. If however the inflammation has existed for any time, or has been violent, an unnatural secretion takes place from the vessels inflamed, which is called pus; this when collected or confined, constitutes an abscess, and when the inflammation ends in this manner, it is said to terminate by suppuration. In cases of much weakness, constitutional or induced, the vascular action in the part shall cease altogether, its excitability be irrecoverably exhausted, and what in scholastic language is termed gangrene be the consequence, which extending, shall form sphacelus, or morification. Resolution, suppuration, gangrene, are therefore the usual modes in which inflammation terminates. There are others, however, which are peculiar to certain parts; thus, an inflammation of the lungs often ends fatally by a copious effusion of a watery matter into the cellular texture of these organs; thus an inflammation of a gland shall end in schirrus, or hardness of the parts.

Species of inflammation. This disorder is systematically divided into two leading species—phlegmonous and erithematic. The first is defined by Dr. Cullen, "an inflammation of a bright-red colour, with a circumscribed pointed tumour, and tending towards suppuration." The erythema has a less vivid colour, with scarcely any tumour, spreading irregularly, burning rather than throbbing pain, and terminating in vesicles.

Indications of the disorder's decline. It scarcely requires to be observed, that a cessation of pain, a reduction of tumour, a loss of redness and heat, a diminution of the systematic disturbance, are all evidences that the inflammation is about to terminate. If however it be suffered to run on into the stage of suppuration, the indications of this state are, the pulse becoming fuller and softer, the patient being attacked with shiverings, and a pulsatory feel in the affected part. The tendency to gangrene is denoted by the tumour losing its redness, and assuming a darker hue; by the sudden cessation of pain; sometimes by blisters arising near or upon the tumour; and, lastly, if the local disorder have been considerable, by a rapid declension of the pulse, and powers of life.

Treatment. The indications of cure are to be deduced from the sthenic or asthenic disposition of the disease, and from the peculiar nature of the part or organ injured.

If inflammation be attended by a full, hard, and vigorous pulse, with other expressions of power, a debilitating plan of treatment is to be adopted; blood is to be drawn from the arm, saline purgatives are to be administered, cold is to be applied, and the exciting powers, as much as possible withdrawn. If, on the contrary, an equal degree of local affection shall be accompanied with feeble, although quick, pulse, and the remaining symptoms of debility, an opposite plan, under certain regulations and exceptions, is to be pursued; stimulants are to be thrown in, and the inflammation cured by impelling and supporting the torpid and feeble powers of the frame. But from the peculiar nature of the part or organ affected, the mode of treatment in the same degree and kind of inflammation will likewise be materially modified. Thus an asthenic affection of the liver requires different stimuli from an asthenic affection of the stomach. But although in inflammation, as in fever, we generally recommend the cool treatment, and consequent free admission of air, it is to be recollected that this principle is objectionable in some kinds of inflammations, as of the lungs. For example, in small-pox and in measles, we shall have the same degree of pyrexia, or fever, present; and cold air would be equally indicated in either, were we to infer the proper method of treatment alone from the inflammatory excitement; but in measles the lungs are often the principal seat of the local affection, an oxygenous or pure atmosphere would prove too stimulating to these organs; and thus if we pursued general doctrines without particular exceptions, or overlooked "the peculiar nature of the part or organ injured," the object of our plans would be frustrated and defeated.

Genus I. *Ophtalmia,* inflammation of the eyes.

Genus II. *Phrenitis,* inflammation of the brain. This, as a sthenic affection, independently of proper maniacal disorder, or febrile affection, is an extremely rare disease.

Symptoms. Redness of the face and eyes impatience of light and sound, watchfulness, and furious delirium.

Methodus memendi, or method of cure. Copius evacuations. "Foment the head with cold water for hours together." Blisters. Blood to be drawn from the temporal artery.

N. B. The delirium of fever, which has been supposed to indicate an inflammation of the brain, is for the most part of an asthenic nature, and requires a stimuli.

Genus III. *Cynanche,* quinsy.

Species 1st. Cynanche tonsillaris, common inflammatory sore throat.

M. M. Acid gargles, Saline purgatives. Blisters. Antimonial diaphoretics.

Species 2nd. Cynanche maligna. An accidental, but very common, symptom of scarlet fever. See SCARLATINA.

Species 3rd. Cynanche trachealis. croup, See INFANCY.

Species 4th. Cynanche pharyngææ, a mere extension into the pharynx of the cynanche tonsillaris.

Species 5th. Cynanche parotidæ. The mumps is an affection of the parotid and maxillary glands, which appears in the form of a

swelling under the jaws; it sometimes appears as an epidemic.

M. M. If delirium supervene upon the retrocession of the swellings, blisters. "Foment the head with warm water." *Darwin.*

Genus IV. *Pneumonia,* inflammation of the lungs.

Genus V. *Carditis,* inflammation of the heart or pericardium.

Genus VI. *Peritonitis,* inflammation of the peritoneum.

The general symptoms are, pyrexia, pain in the chest, difficulty of breathing, cough: and if the disorder happen in the sthenic diathesis, the pulse is hard and frequent. Sometimes the expectoration is tinged with blood.

The particular symptoms are, in carditis, palpitation, with unequal intermitting pulse, pain in the region of the heart, vomiting, fainting: if the inflammation be particularly directed to the diaphragm, the pain is situated towards the lower ribs, the respiration in a recumbent posture is extremely difficult, and the corners of the mouth are sometimes so retracted as to form a disagreeable smile, called risus sardonicus.

M. M. If the constitution is sthenic, and the disorder urgent, immediate and copious bleeding. Refrigerant and emollient cathartics. Cool and equal, not cold and irregular, atmosphere. Diluent drinks. Total abstinence from animal food, sometimes during the first five days. Antimonial preparations. After venesection a blister on the pained part. Digitalis. Small doses of calomel to prevent adhesions. If pneumonia run on into suppurations pus will be discharged by cough, and thus a species of consumption be formed; or will be detained in the cavity of the chest, and constitute empyema. In either case, digitalis in large doses. Calomel. Opium. Peruvian bark.

Genus VII. *Gastritis,* inflammation of the stomach.

Symptoms. Violent pain in the region of the stomach, with pyrexia; small, frequent, and sometimes contracted, pulse; vomiting; hiccough.

Causes. It may be occasioned by any thing acrid taken into the stomach: by blows on the region of this organ; and a slight species of it is often consequent upon taking cold liquids after exercise.

M. M. In inflammation of the stomach and bowels we have, in some measure an exception to the general rule of cure, according as the disease appears sthenic or asthenic. The pulse and vital powers are often suddenly reduced, and yet venesection is required. Warm bath. Fomentations. Anodyne and mucilaginous clysters. Blisters on the pained part.

Genus VIII. *Enteritis,* inflammation of the bowels; fixed and distressing pain in the bowels. Pyrexia; pulse always quick, sometimes hard.

Causes. The same as of gastritis. Likewise strangulated hernia, spasmodic colic, introsusception.

M. M. The same as in gastritis after the urgent symptoms have subsided. Small doses of calomel and opium.

Genus IX. *Hepatitis,* inflammation of the liver.

Symptoms. Pain in the region of the liver, extending to the clavicle and top of the right shoulder; difficulty of lying, on the left side especially. Pyrexia; high-coloured urine; pulse frequent, strong, and often hard. Bilious evacuations, or jaundice. The tendency of the disease is to suppuration.

M. M. Copious and repeated bleeding before the suppurative process has commenced. Calomel, and cathartics of the refrigerant class. Digitalis in considerable doses. Blisters to the region of the liver.

If suppuration takes place, the matter makes its way through the lungs, or the intestinal canal, into the cavity of the abdomen, or through the peritoneum to the surface. During this process opium and bark.

A species of chronic hepatitis is more usual in Britain, and indeed is one of our most common maladies, especially among dram-drinkers.

Symptoms. Obtuse and weighty kind of sensation in the region of the liver; difficulty of lying on the left side; pain in the right shoulder; the countenance slightly marked by hectic; dejection of spirits. Œdema of the ancles.

M. M. Small doses of calomel, with, or without opium. Tonic bitters, such as quassia or gentian. An abstinence from spirituous liquors.

Genus X. *Splenitis,* inflammation of the spleen.

Symptoms. Tension; tumour; heat of the left side; pyrexia; pain increased by pressure.

M. M. Blisters, cathartics, calomel, and digitalis.

Genus XI. *Nephritis,* inflammation of the kidneys.

Symptoms. Pyrexia; pain in the lumbar regions; retraction of the testicle; numbness of the thigh; vomiting; costiveness.

Causes. Alternations of heat and cold: external violence, &c. as in other inflammations, but chiefly in calculi.

M. M. Venæsection. Digitalis, and opium. Nitrous æther. Emollient clysters. Castor oil. Demulcents.

Genus XII. *Cystitis,* inflammation of the bladder.

Pyrexia. Pain and tumour above the pubes; pain in discharging urine: tenesmus.

M. M. Venæsection. Warm bath. Anodyne clysters. Diluents.

Genus XIII. *Hysteritis,* inflammation of the womb.

Heat, pain, tension, and swelling, in the lower belly; pyrexia; vomiting.

M. M. Venæsection. Mucilaginous clysters, with opiates. Anodyne fomentations.

Genus XIV. *Rheumatismus.*

Pyrexia; pains in the joints, frequently extending along the muscles; heat and tumour on the part.

M. M. Leeches to the inflamed joints. Volatile embrocations after the inflammation has in some measure subsided. Calomel, and opium. Sudorifics. Warm bath. Peruvian bark in chronic rheumatism. Volatile tincture of gum guaiacum. Flesh-brush. Sea-bathing. Electricity. Bath waters.

Genus XV. *Odontalgia,* tooth-ache.

Genus XVI. *Podagra,* gout.

Symptoms. Pain in the joints, principally

of the great toe, and especially of the hands and feet returning at intervals Previously to the accession of the inflammation the functions of the stomach are generally disturbed. The fits generally come on in the morning.

Causes and peculiarities. Gout is invariably a disease of the asthenic diathesis. It is produced in a system predisposed to its influence by the indirectly debilitating powers; such as a too liberal indulgence in fermented and spirituous liquor, high-seasoned meats, &c. and likewise by the directly debilitating powers of vegetable and watery food, depressing passions, &c The inflammation of this disease often alternates with, and appears in a manner vicarious of, torpor in other parts of the system; as of the brain producing apoplexy, the stomach constituting dyspepsy, and of the liver giving rise to jaundice: all which symptoms indeed may be considered as part of the disease. On this account gout has been divided into the atonic; that is, where a disposition to the inflammation of the foot is observable, but does not actually take place, the retrocedent, where, after the continuance for some time of such inflammation, it shall seem to be transferred to another part, and thus form a gouty inflammation of the stomach, or other organs; and, lastly, the misplaced, in which the gouty tendency, instead of displaying itself in its ordinary course, falls upon some other organs, as the lungs, the stomach, or the brain.

M. M. In treating gout it should never be forgotten that it is an asthenic disease: while excitement is kept up in the system the paroxysms are suspended. The irregular affections in gout must be combated by stimulants carefully adapted to the excitability; for the spasmodic affections of the stomach, aromatics and bitters, as ginger and quassia. If the head is affected, camphor, musk, ether, opium; these likewise are remedies for the gouty asthma. The Portland powder, which is a composition of bitters and aromatics, may prove highly useful. Regular and steady, and not capricious and merely temporary, abstinence from wine, spirits, and spices. The body to be preserved gently open. Pure air, moderate exercise, encouragement of cheerful habits. Warm and cold sea-bathing. Bath waters. Very small doses of digitalis.

ORDER III.—*Exanthemata,* Eruptions.

The exanthemata are more nearly allied to genuine fever than those disorders of which we have just been treating, as the local affections are consequences rather than causes of the general irritation. They have been called eruptive fevers. They are defined by Cullen, contagious diseases, affecting a person only once during the whole of life, commencing with fever, and succeeded by eruption on the skin.

Genus I. ***Erysipelas,*** St. Anthony's fire.

Symptoms. This disease does not correspond with the whole of the above definition; it is not contagious; and it has frequently been found to recur. The face is the more ordinary seat of this affection. After febrile irritation has commenced, and continued for a short time, during which there is often an unusual drowsiness, and sometimes delirium, the face suddenly becomes bloated, the eye-lids swell, and the skin is red and blistered. If the disorder is violent, or ill-treated, the inflammation and redness extend down the neck, and spread sometimes on the shoulders; the tumid appearance of the countenance increases, delirium supervenes, and the patient has been known to die apoplectic. The erysipelas is an erythematic inflammation. Its seat is the rete mucosum. Its tendency is to gangrene rather than to suppuration. A fatal termination is said to be principally on the 7th, 9th, or 11th days

M. M. In no other affection is it of more urgent moment to decide on the treatment by the nature of the prevailing diathesis. It has been observed, that in large and populous cities St. Anthony's fire almost always appears in the form of asthenia; and in this case requires wine, bark, opium: while in the hardy constitution of the rustic it assumes a sthenic character, and demands the vigorous employment of what has been called the antiphlogistic regimen. Venesection. Saline purgatives. Diluent drinks.

Genus II. ***Pestis,*** the plague, is an epidemic typhoid fever.

Genus III. *Variola,* small pox.

Symptoms. After the pyrexial symptoms have continued for three days eruptions appear on the skin, which on the eighth day contain pus, and at length fall off in crusts.

Species. The small-pox is divided into the distinct, and confluent: the first has more of the sthenic, the latter of the asthenic character. In the former the eruptions are of a phlegmonic, in the latter of an erythematic or spreading nature.

The eruption of the distinct small pox makes its appearance in circumscribed red spots on the face; in the course of two days the body and legs receive their portion. The fever now ceases, the face swells, the pustules enlarge, and on the eighth day are mature. The swelling of the face now goes off, and the hands and feet begin to swell, with a slight return of fever, which soon declines.

In the confluent, or asthenic species, the fits are not so regular; the eruptions are not circumscribed and prominent, but diffused, and scarcely appearing above the skin; a kind of erysipelas sometimes precedes them, and every symptom denotes debility. The fatal termination is often on the eleventh day.

Inoculation. The advantages of inoculation for the small-pox need not be insisted on. The only cautions requisite in preparing for inoculation, are to preserve the bowels free from sordes, and to choose a time for the insertion of the matter when teething, or other irritative processes, are not going on in the system. With respect to the time, inoculation ought to be performed either before the second month or after the second year.

M. M. Cold air. The bowels to be preserved open. Animal food to be denied. If the fever runs high, antimonials and nitre. In the confluent species, the alimentary and intestinal canal is with the utmost solicitude to be preserved free from congestions by purgatives, and the powers of the system supported by opium, bark, small doses of nitre, wine, pure air; vinegar aspersed about the bed, walls, and floor of the apartment. Pediluvium.

Genus IV *Varicella.* The chicken-pox is a very slight disease: the eruptions somtimes assume nearly the character of the distinct

small-pox; but there is not much irritation of the system, and they generally disappear in the course of three or four days from their first breaking out.

Genus V. *Rubeola.* Measles.

Symptoms. Pyrexia, sneezing, inflamed eyes, dry cough, drowsiness; about the fourth day, or later, small red points appear on the skin, which in the course of about three days fall off in branny scales.

M. M. Measles too often lay the foundation of pulmonary consumption, to prevent which the symptoms denoting inflammation of the lungs are to be with much solicitude obviated; and for this purpose small doses of tincture of digitalis are to be preferred to every other medicine. Steady and cool atmosphere, not cold air in currents. Refrigerant cathartics, with calomel. Animal food not to be given. Digitalis, with a very small quantity of opium, for the cough succeeding to measles.

Genus VI. *Miliaria,* miliary fever, is merely a symptomatic eruption of small red pimples about the neck and face, which in two days become white pustules, and desquamate. They have a peculiar smell. Much anxiety and difficulty of breathing precede the eruption. This disorder appears to be a consequence of an improper heating regimen in fever.

Genus VII. *Scarlatina,* scarlet fever.

Symptoms, &c. After pyrexia has lasted about four days, a scarlet eruption appears on the skin, sometimes attended with inflamed tonsils and cervical glands: these last sometimes appear without cutaneous eruption, and the disease has been called cynanche maligna. This disorder is very irregular in its aspect; and often, without much care, fatal in its termination. The unfavourable symptoms are the same as in other fevers. It is a disease principally of children.

M. M. Cold affusion. Cold air. Antimonia's, opium, bark, wine, saline purgatives or enemas, nitre, blisters. See the section on Fever in this article.

Genus VIII. *Urticaria,* nettle-rash. After pyrexia for a day, small red spots, like the stinging of nettles, appear on the skin, which almost vanish during the day, but return in the evening. It scarcely requires any medical treatment. The disease does not last more than two or three days.

Genus IX *Aphtha,* thrush. Spots on the fauces and tongue, by which this disorder is constituted, are almost always symptomatic of other diseased states.

Genus X. *Pemphigus,* "a fever attended by successive eruptions of vesicles about the size of almonds, which are filled with a yellowish serum, and in three or four days subside." The treatment is to be regulated by the nature of the attendant fever.

ORDER IV. *Hemorrhagiæ* Discharges of blood,

The definition of this order is, pyrexia, with profusion of blood, without any external violence: blood when drawn from a vein shewing the buffy coat.

Genus I. *Epistaxis,* bleeding from the nose

Symptoms. Pain or fulness of the head, giddiness, dimness of vision, drowsiness, irritation of the nostrils

M. M. Cold applied to the neck and head. Mechanical pressure, or absorbing substances, to the nostrils. Acids and astringents internally. Avoiding irritation of the body or mind. The bowels to be kept gently open. Nourishing but not stimulating aliment. In the epistaxis of old people, and in cases of much weakness, bark, vitriolic acid, opium. If the disorder is violent, and have depended upon the suppression of some other discharge, such discharge to be restored.

Genus II. *Hemoptysis.* Spitting of blood. Symptoms. Redness of the cheeks, a sensation of weight in the breast, difficult respiration. Saltish taste in the mouth, irritation in the trachæa, coughing up of florid blood.

Causes. Violent irritation of mind or body, sudden vicissitudes of heat and cold, too powerful exertion of the lungs, as in singing, coughing, playing upon wind instruments.

M. M. All irritation and irregularities to be carefully guarded against. Bowels to be kept evacuated by mild purgatives. Manna. Tamarinds. Peruvian or oak-bark, combined with mineral acids, especially, the sulphuric opium. Digitalis in large doses, so as to occasion nausea. "A table-spoonful of common salt." Procure a return of the obstructed discharge.

Phthisis pulmonalis, consumption of the lungs.

Symptoms. Emaciation, weakness, cough, hectic fever, and for the most part an expectoration of pus.

Causes. Pthisical ulceration of the lungs, or confirmed consumption, is ordinarily produced through the medium of tubercles, or small bodies, in the cellular texture of these organs, which by repeated and gradual irritation, at length come to ulcerate and destroy the fabric of the lungs, and produce the symptoms of fully-formed phthisis.

The more immediately exciting cause of pulmonary consumption is generally an exposure to cold, which operates in the manner described under the section catarrh. Consumption, however, may be brought on by amenorrhœa, lues venerea, unseasonably repelled eruptive action on the surface, mental affections, &c.

M. M. In no case, perhaps, is neglect or early mismanagement of disease more pregnant with irremediable evils, than in the instance of consumptive affections. Digitalis properly and timely had recourse to is "the anchor of hope." Warm bathing. A regular temperature in the air that the person breathes. Warm cloathing. Avoiding currents of air. Assiduously guarding against damp, and especially cold application to the feet, as by sitting with the feet on a stone floor, or an oil cloth. Milk diet. Avoiding all spirituous liquors, and spiced or high-seasoned meats. Keeping the bowels gently open by manna, castor-oil, senna, &c. When the lungs have actually become ulcerated after gradual and protracted irritation, very little expectation of recovery can remain. Griffith's mixture, composed of steel, myrrh, and alkali. Digitalis in larger doses, and combined with the above tonic. Uva ursi opium and vitriolic acid. Digitalis combined with calomel. Change of climate. If a tendency to absorption from the surface of pulmonary ulcer could be induced greater than the deposition of it, we might have some prospect of curing

the disease, in its advanced stages. In order to produce this absorption, sailing so as to occasion sea-sickness has been had recourse to. Swinging, riding in a carriage, and other modes of occasioning a degree of vertiginous affection, and consequent nausea, have likewise been recommended and practised. In the confirmed stages of phthisis, animal diet which is nutritive, without being stimulant, ought to be advised.

Genus III. *Hæmorrhois*, the piles.

Weight and pain of the head, vertigo, pain in the anus and loins, swellings and flux of blood from the anus.

M. M. If symptoms of arterial activity accompany the hæmorrhoids, vitriolic acid, with moderate astringents, such as infusion of roses. Temperance, exercise, abstinence from spirituous liquors and spices. Tamarinds. Leniti electuary, sulphur, crystals of tartar. Castor oil. Warm fomentation, by sitting over the steam of heated water. Leeches.

When the hæmorrhoidal flux is attended with much debility, while the bowels are kept open by castor oil and other similar purgatives, the more powerful astringents are to be employed. Steel. Exercise. Generous diet. Cheerful train of thinking.

Genus IV. *Monorrhagia*, immoderate menstrual flux.

Symptoms. Pain in the back and loins, vertigo, difficulty of breathing, flushes of heat and cold, frequent pulse; in cases where the disease is more directly from debility, loss of appetite, paleness of countenance, coldness of the limbs, œdematous swellings about the ancles.

M. M. In the first species, the menstrual irregularity arises from hysteric or nervous affections, and other violent passions. Avoid stimuli of all kinds, mental or physical. Refrigerant cathartics, if costiveness be present. Moderate astringents, such as infusion of roses, and the sulphuric acid. In the menorrhagia of direct debility, astringents, cordials, and stimulants. Peruvian bark and sulphuric acid, opium, alum, port wine. External application of cold water or vinegar. Steel.

ORDER V. *Profluvia.*

Genus I. *Catarrhus*, a cold.

Symptoms. Pyrexia, with increased discharge from the mucous membrane of the nostrils, and in violent cases of the fauces and bronchiæ, with cough.

M. M. Moderate and equal temperature. The bowels to be kept gently open. If the febrile irritation is considerable, sudorifics. Antimonials, nitre. Oleaginous substances may be used to allay the cough; but irritating balsams are in the highest degree detrimental. Liquorice, honey, boiled fig, almond emulsion.

If the phthisical tendency is conspicuous, digitalis.

Genus II. *Dysenteria*, dysentery.

Symptoms. Frequent stools, mixed with mucus, and sometimes with blood, attended with griping and tenesmus, the proper alvine excretions being retained; pyrexia, pulse quick and feeble. The disease is sometimes contagious and epidemic.

Causes. Dysentery depends upon the irritability of weakness, determined by particular circumstances to the alimentary canal; its predisposing and exciting causes are alternations of heat and cold, more especially when accompanied by damp, as when an army is encamped on marshy ground; the putrid miasma arising from the marshes; the contagious effluvia proceeding from the discharge in the disease; and, according to Sir John Pringle, from dead bodies left unburied in the field of battle.

The immediate cause of the symptoms seems to be, a spasmodic construction of the larger intestines, retaining the fæces.

M. M. Calomel, opium, and rhubarb, to relieve the spasm, and discharge the contents of the bowels. Mucilaginous clysters, as of starch with tincture of opium. Emetics. Small doses frequently repeated of ipecacuan. Colombo. Peruvian bark. Warm bathing.

CLASS II. *Neuroses*, Nervous diseases.

Nervous diseases are affections of either sense or motion; without idiopathetic pyrexia, or visible disease of parts.

1. Comata. A diminution of voluntary motion, with sleep or impaired senses.
2. Adynamiæ, a diminution of the involuntary motions of either natural or vital functions.
3. Spasmi, morbid motions of muscular fibre.
4. Vesaniæ, disorders of the judgment or intellect without primary pyrexia or observable affection of any particular part of the body.

ORDER I. *Comata.*

Genus I. *Apoplexia*, apoplexy.

Symptoms. Abolition of the sentient and locomotive faculties, the sleep in general attended with snoring. The respiration, motion of the heart, and other involuntary actions, remaining. We conclude from analogy, that there is some degree of pressure on the brain in almost all cases of apoplectic stupor.

Apoplexy may be divided into sthenic and asthenic. If a vigorous and plethoric man, sitting down to his dinner and his glass, suddenly, during the excitement of conviviality, of mirth, and of alcohol, fall on the floor with deprivation of sense and apoplectic stertor, it must be evident that the fit has been induced by a greater flow of arterial blood into the vessels of the brain, than the veins of this organ could, in due time, convey away. The apoplexy has been induced in the manner of a sthenic disease.

If, on the other hand, a debauched and debilitated individual be the subject of an apoplectic attack, at the time when the excitement of intoxication shall have been succeeded by the condition of indirect debility, the disease will here have been brought about in a different manner; the impetus in the vessels of the brain shall have partaken of the general diminution of power throughout the whole system; sluggish vascular action shall have caused congestion; which congestion, in union with the deficient excitement on which it had depended, shall have induced that sudden suspension of the sentient faculty which constitutes the apoplectic paroxysm.

M. M. If the disease is sthenic, and the physicians are called in while the paroxysm still continues, immediate and copious bleeding from the arm, the jugular veins, or the temporal artery. Every ligature about the patient's body, especially about the neck, to be loosened immediately. Press hard with the thumb and fore-finger upon the carotid arteries, taking care to avoid the jugular veins. Place the head of the patient high on his pillow, or seat him erect in a chair. Preserve the apartment cool. Cold water may in some cases be applied vigorously to the forehead and temples. Afterwards saline purges, and subacid drinks. Enemas. Careful preservation from irregular and violent excitations, either of body or mind. In the asthenic, and by far the most usual form of the complaint, bleeding with much less freedom and only during the paroxysm. It is better to open the temporal artery, if convenient, than to bleed from the arm or jugulars. The application of cupping-glasses is still preferable; apply blisters to the neck. When the power of deglutition has returned, cordials and stimulants. Opium and wine in very small doses. Volatile alkali. Sprinkle vinegar about the room. To prevent the returns of the fits; tonics, particularly bitters, as colombo, gentian, quassia: exercise and mental amusement, without violent excitation. Preserve the body regularly open, without violent purgations. Avoid sudden exposure to cold, especially cold and wet feet. If the fit has followed the suppression of any accustomed discharge, or cutaneous eruption, let them, if possible, be restored.

Genus II. *Paralysis*, palsy.

Partial interruption of the loco-motive faculty, sometimes with a degree of apoplectic stertor. This is partial apoplexy, arising from similar causes operating in a less degree. It sometimes succeeds to a full fit of apoplexy, and continues for months, or during life. The palsy often affects the whole of one side, and is confined to that side; hence it has been supposed, that the injury of the brain is likewise partial.

M. M. Ascertain the exciting cause, and if possible counteract it. Emetics, purgatives, preceding stimulants and tonics. Tonics and stimulants the same as in asthenic apoplexy. Volatile embrocations to the paralyzed side or limb. Warm bath. Bath waters. Electricity. Galvanism.

ORDER II. *Adynamiæ.*

Genus I. *Syncope*, fainting.

Symptoms. A diminution or even, for a time, a total cessation, in the action of the heart.

Fainting may arise from passions of the mind: from sudden reduction of stimulus, as from bleeding, or drawing off the waters in dropsy; violent pain; the irritation of worms, or other crudities, in the stomach and bowels: much heat, offensive effluvia, &c.

M. M. Immediately obviate, if possible, the exciting cause. Endeavour to restore sensation by aspersing cold water on the face and neck; attempts to force down a small quantity of brandy: and in all cases, but more especially when the affection arises from impure air, throw open the windows, and prevent compassionate spectators from crowding round the insensible patient.

Genus II. *Dyspepsia*, indigestion.

Symptoms. Deficient, or depraved appetite; nausea; vomiting; inflation from flatulence; heart-burn; pain in the stomach, especially when the body is in a bent position; oppressed breathing; costiveness.

This disease evidently arises from the same sources as other affections of weakness: these are, intemperate use of spirituous liquors, and of tea; exposure to damp and cold; irregular hours of repose; intense study; mental depression and anxiety.

M M. Purgatives, with calomel, previously to giving tonics. An emetic. Columbo, gentian quassia. Magnesia, in order to neutralize the acidity, and ease the consequent pain of heart-burn. Cold or shower bath, in very warm, and warm bathing in cold weather. A glass of warm water after dinner and supper.

Genus III. *Hypochondriasis*, low spirits.

Indigestion, with languor, and causeless apprehension of evil, more especially as it relates to the patient's state of health.

M. M. Aim at converting solicitude and apprehension into confidence and hope; not by deriding the feelings of the hypochondriac, and treating them as fanciful, but by breaking the chain of diseased associations. Procure a gradual change of scene and of habits. Bath waters. Warm bathing. Preserve carefully the alimentary canal free from colluvies and viscidities by drastic purges and calomel. Maintain a regular moisture of the skin, without copious perspiration. Tonics with aromatics.

Genus IV. *Chlorosis*, green-sickness.

Dyspepsia; paleness of the skin and of the lips; lassitude; difficult breathing, and palpitation of the heart, after using more exercise than usual; pulse small, feeble, and sometimes very quick: coldness of the extremities; appetite deficient, and oftentimes depraved; pain in the back and loins; costiveness; œdematous ancles, especially towards evening; and obstructed menstruation.

M. M. Almost as certainly as some kinds of pain yield to opium, does even obstinate chlorosis fall before the power of steel. It is necessary, however, frequently to commence with an emetic; and in almost all cases it is proper to give a purgative, joined with calomel, before the administration of steel. Tonic bitters. Aromatics. Moderate exercise in a pure atmosphere. Meat diet. A bath of about eighty degrees. Marriage.

ORDER III. *Spasmi.* Spasms.

SECT. I. *Spasmodic affections in the animal functions.*

Genus I. *Tetanus.* A spasmodic rigidity of a great part of the body: in some instances it is drawn violently backward, at others forwards, and in both cases the disease is generally followed or attended by trismus or lock-jaw. The immediately exciting causes of tetanus are, wounds or pricks of tendons; the sudden application of cold after extreme heat; great intemperance, or other vices: the disease may likewise be consequent upon viscid mucus, worms, and other irritating substances, in the alimentary passages.

M. M. Pouring large quantities of cold water over the body during the spasm, in order forcibly to sever the catenated motions by which it is constituted. Warm bathing. Very large quantities of opium. Other antispasmodic medicine. Mercury. If the spasm has originated from a lacerated or punctured tendon, divide it freely, and produce pain and inflammation.

Genus II. *Convulsio,* convulsions. On the cause and treatment of these, we need not enlarge, after the remarks we have introduced on the nature, predisposing and exciting causes, of convulsive and spasmodic disorders in general.

Genus III. *Chorea,* St. Vitus's dance.

Symptoms. Convulsive agitations of the limbs, in general almost confined to one side of the body. When the patient attempts to walk, he produces involuntary gesticulations.

M. M. Emetics, cathartics with calomel; anthelmintics; bark, steel, and other tonics; electricity, galvanism, tepid bathing, sea-bathing.

Genus IV. *Raphania,* contractions in the joints.

Symptoms. Spastic contractions of the joints, with excruciating pain, and convulsive motions, returning periodically, and continuing for many days. It appears to be a species of rheumatism.

M. M. Purges, followed by tonics; mercury combined with opium.

Genus V. *Epilepsia,* epilepsy. Violent convulsions of the muscles, attended with sleep.

Epilepsy in its nature and causes appears to hold a kind of intermediate situation between apoplexy and convulsion; it has the sudden fall and the sopor of the one, with the irregular muscular action of the other.

M. M. Epileptic fits are sometimes congenital, hereditary, and depend upon some occult state of the nervous system. In these cases the disorder is generally irremediable. All that can be done by art is merely to ascertain, and endeavour, if possible, to obviate the exciting causes of the disease; and during the paroxysm to loosen every bandage about the neck and head, preserve the apartment as airy as possible, and be careful that the patient do not inflict injury upon himself by the violence of his agitation.

Particular attention is to be given to the predisposing and exciting cause or causes, which are extremely numerous; such as youthful intemperance, indulgence in secret vices, mental passions and affections, imitation of other epileptics, lively recollections of previous impressions, repelled eruptions or discharges, sudden alternations of the extremes of temperature, unpleasant odours, and worms. These causes must all necessarily be removed before the physician can have the least prospect of overcoming the disease. Emetics, cathartics, with calomel; anthelmintics: suddenly dissever the chain of associations, by plunging the patient in the cold bath, or dashing with violence cold water over his naked body.

Of Worms and Anthelmintics.

Intestinal worms are of three kinds; the ascaridis, or small thread-like worm; the lumbricus teres, or round worm; and the tænia, or tape worm. The first of these are principally confined to the rectum. The symptoms by which the presence of these may be suspected, are an uneasiness and itching in the rectum, especially urgent towards evening: this, if violent, disturbs sleep, and occasions febrile irritation, and sometimes tenesmus, with mucous discharge from the anus, indigestion, and itching of the nostrils.

M. M. Clysters of lime-water, injection of tobacco-smoke. Mercurial ointment introduced into the anus. Aloes and steel, both by the mouth and in the form of enema. Saline purgatives. Harrowgate water, so as to induce six or seven stools every morning. The lumbricus is the most common. Lumbrici are of very different lengths and magnitude; they are principally found in the smaller intestines, but are situated occasionally both in the stomach and larger intestines. These worms have been known to pierce through the coats of the alimentary canal, and have thus occasioned most excruciating pains and death. The tape-worms are sometimes voided of an enormous length; they have been stated to be from two to forty feet long. They properly consist of an united chain of separate animals; as, when broken, each portion has the power of reproduction. The symptoms are much the same with those of the lumbrici, but more urgent.

M. M. Dolichos pruriens, cowhage. E. and W. Indies. This substance is the down growing on the pods of the plant.

Ferrum, iron.—The filings and rust.

Stannum, tin.—This is used in the form of power. Tin may perhaps operate by a mechanical hower. Dose, one or two drachms.

Submurias hydrargiri.—Calomel is perhaps the most efficacious of all the anthelmentics. Dose ten or twelve grains to an adult.

Spasmodic Affections continued.

SECT. II. *In the vital Functions.*

Genus I. *Palpitatio,* palpitation See Syncope.

Genus II. *Asthma.*

Symptoms. Difficult respiration returning at intervals, with a sense of tightness across the breast. Wheezing at the commencement of the asthmatic fits; scarcely any cough but what is hard; towards the close of the paroxysm it however becomes more free, attended with a discharge of mucus.

The causes of asthma are numerous, while its predisposition is often hereditary, and dependant upon a peculiar conformation and temperament; the actual disease may be excited by intemperance either in eating or drinking, violent exercise, mental agitation, eruptions or discharges abruptly or unseasonably repelled; the fumes of metallic poison, as of lead, &c.

M. M. Spasmodic asthma, when fully established, scarcely admits of a radical cure. The paroxysms to be relieved by opium and æther; coffee; tonics in the intervals principally of the class of bitters and aromatics. Avoid distending the stomach inordinately. Emetics; enemas previous to the expected accession; gentle horse exercise; pure air; oxygen gas. If eruptions have been repelled, endeavour to restore them.

Genus III. *Dyspnœa*, difficulty of breathing. This is improperly introduced into the nosology as a genus, it being merely a symptom of other diseases, consequent upon defective formation of the chest, or brought on by evident causes, which being removed, the disorder immediately declines.

Genus IV. *Pertussis*, hooping cough.

Symptoms. Convulsive strangulating cough, with noisy inspiration or hooping, and sometimes attended with vomiting. It is contagious.

M. M. Antimonial emetics. Very small doses. Warm bathing. Above all, digitalis; in no disease, perhaps, is the power of this valuable medicine displayed more forcibly and evidently than in hooping cough. Its effects are generally almost instantaneous. After the violence of the disease has subsided, and even before, change of air.

SECT. III. *In the animal functions.*

Genus I. *Pyrasis.* Water-brash of Scotland. Water-qualm.

Symptoms. Sudden eructation of watery fluid with or without heartburn; the fluid brought from the stomach sometimes insipid.

M. M. Inhalation of tobacco smoke. A grain of opium twice a day, soap, iron powder, a blister.

Genus II. *Colica*, colic.

Symptoms. Permanent and excruciating pain in the belly, with a sensation as of twisting about the navel, constipation, and sometimes vomiting

Causes. These symptoms may be occasioned by indigestible food, the sudden application of cold; acrid substances received into the stomach; poisons, especially lead hence colic is a kind of epidemic disease among painters, attended with paralysis of the arms, &c.

M. M. Opium. Cathartics, principally of castor oil. Warm bathing. Anodyne clysters. Fomentations and blisters to the part. In obstinate cases of the painters' colic, Bath waters. Carefully obviate the exciting causes of the disease.

Genus III. *Cholera.*

Symptoms. Vomiting and purging of bilious matter, violent pains in the stomach and bowels, with great anxiety and irritability.

Cholera is one of the diseases of the autumnal months: it is very often produced by the sudden succession of cold to unusually warm weather: it sometimes follows the taking of indigestible substances, as of much cold cucumber.

M. M. During the violence of the vomiting and purging, give water-gruel, and inject starch clysters, to each of which add tincture of opium. After the disorder has in some measure subsided, restore due excitement by cordial and nourishing diet, with stomachic medicines. If frebrile irritation is induced, the saline draught, composed of salt of wormwood and lemon-juice.

Genus IV. *Diarrhœa.*

Symptoms. Frequent stools, without primary pyrexia, and not induced by contagion.

A morbid action in the excretories of the intestines constitutes this disease; sometimes however, and frequently, purging arises from mere loss of excitability in the intestinal fibre; without increase either of bile or any other excretion It is immediately occasioned by acrid matter in the intestines; by acidities, by mental passions, or by the sudden application of cold, more especially to the feet.

M. M. According to the exciting causes. If there is reason to suspect the lodgment of acrid matter, calomel, with jalap, senna, or rhubarb. Afterwards astringents, of which one of the best is good red wine. Opium. Chalk, if acidity prevails. An emetic if the disorder continues obstinate.

Genus V. *Diabetes.*

Symptoms. Superabundant discharge of urine, in some cases amounting to fifty pounds in twenty-four hours, limpid and sweetish to the taste, with urgent and perpetual thirst, dry skin, weakness, emaciation.

M. M. Animal diet. Alkaline and astringent medicines, such as nut-galls and lime-water. Bark. Steel. Opium. Alum-whey.

Genus VI. *Hysteria.* The hysteric disease.

Symptoms. A gurgling of the bowels, followed by globus hystericus, or a sensation of a ball ascending to the throat, and menacing suffocation. Convulsive agitations, alternate laughing and crying, a general fickleness and irritability of mind. A large quantity a straw-coloured or limpid urine. Hysteria, like epilepsy, generally first occurs in females about the time of puberty. It is, a systom of a lax habit, and is consequent upon the irritability of weakness. It may be brought on by mental agitation or by irritations in the stomach, bowels, uterine organs, &c.

M. M. Avoid every occasional and exciting cause of the disease. Bark, quassia, and other tonics. To remove the present symptoms, camphor, asafœtida, castor opium; if this last, from idiosyncracy, disagrees with the patient, the hyoscyamus will generally be found an excellent substitute. Emetics.

Genus VII. *Hydrophobia.*

A dread of water as exciting painful convulsions of the pharynx caused for the most part by the bite of a mad dog, violent spasms, furious insanity, death.

M. M. Dr. Thornton advised the application of hot vinegar, sharpened with vitriolic acid, to the wounds of five men who had been bitten by a rabid animal, and this application was attended with seeming success. Mercury: this by some has been extolled as a specific for hydrophobia. See HYDROPHOBIA.

ORDER IV. *Vesaniæ.*

Disorders of the intellect independant of pyrexia or coma.

Genus I *Amentia*, ideocy.

Amentia is defined an imbecility of judgment, preventing the perception or the recollection of the relations of things.

There are three species: connate; from old age; from intemperance, and other external causes. When firmly established, little hopes of recovery can be entertained

Genus II.—Melancholia

Genus III.—Mania.

Insanity is intensity of idea, converting imagination into implicit belief, and thus producing an incongruity of action. It par-

takes of the character of mania or melancholia, of a violent rage or gloomy despondency, according to the previous temperament of the sufferer, and the nature of the prevailing idea.

M. M. Endeavour to draw off the mind from the prevailing idea, or otherwise to convince the maniac of the errors of his conceptions, and fallacy of his pretensions, by relating the incongruous conceits of other maniacs which have some affinity with his own. In incipient and equivocal madness, cautiously abstain from expressing suspicions in the hearing of the patient. "Nothing is more calculated to make a person mad than the idea of being thought so." On this account, premature confinement is to be deprecated, as injudicious in the extreme. Those who are placed over the insane as guardians, should unite decision and firmness of character with tenderness of disposition and gentleness of manners.

In strong plethoric habits, venesection. Cathartics. These last, especially in melancholy, often require to be of the drastic kind, and united with calomel. "Diarrhœa very often proves a natural cure of insanity." Vomits. Camphor. Opium in large doses Cold bathing during the violence of the paroxysms, and in some cases, warm bathing in the intervals. During the urgency of phrenzy, apply cold water to the head. Clay cap. Blisters to the scalp. In some cases the production of a vertiginous state, by a rotatory swing, has been found effectual in breaking the morbid associations constituting phrenetic and melancholy paroxysms. Digitalis in very large doses, but regulated with care. Introducing a new disease, which is of a trivial nature, and easy of cure.

Genus IV.—*Oneirodynia* is a violent and distressing imagination in time of sleep. It is divided into two species: the active, or that exciting to walking and various other motions; and the gravans, with a sense of weight or pressure on the chest. This last is the incubus of authors, or night-mare.

The incubus, or night-mare, appears to arise from an interruption of the circulation of blood through the lungs, from defective irritability in these organs, induced by fatigue, mental oppression, a full supper, and wine; which last, in some persons, will almost invariably induce the disease.

M. M. Temperance; especially moderate suppers. "To sleep on a hard bed with the head raised." Emetics. Pugatives of aloes and calomel. Tonics. Sleeping in a large airy apartment, and without curtains to the bed.

CLASS III. *Cachexiæ.* Cachexies.

ORDER I. *Marcores.*

A wasting of the body or general emaciation.

Genus I. *Tabes.* Asthenia, emaciation, and hectic.

Genus II. *Atrophia.* Asthenia, and emaciation without hectic.

M. M. In atrophia, a supply of nourishment, equivalent to the loss that may have been sustained; if emaciation has arisen from mental disturbances, the remedies must chiefly be made to apply to the mind. Tonics from the vegetable class, such as colomba, quassia, and gentian; not steel. Abate the febrile irritation, by keeping the bowels gently open by the milder purgatives, such as manna, senna, and castor oil. Preserve a slight moisture of the skin by small doses of antimonials. Regular and moderate, not violent or agitating exercise. Shower-bath in very warm, tepid bathing in cold weather. Pure air.

In tabes, or emaciation, accompanied by primary hectic. An emetic, to accomplish the double purpose of forcibly expelling ventricular and intestinal acidities, and exciting the languid absorbents. Drastic purgatives, as jalap or aloes, with calomel, with the same intention. Steel, in conjunction with Peruvian bark or bitters. Horse exercise. Warm bathing.

ORDER II. *Intumescentiæ, general swellings.*

Sect. I. *Adiposæ.* Fatty swellings.

Genus I. *Polysarcia,* obesity. This arises from the deposition of oil in the adipose membrane becoming disproportionate to the requisitions of the body.

M. M. Temperance, exercise, less animal food, early rising.

Sect. II. *Flatuosæ,* windy swellings.

Genus I. *Pneumatosis,* a tense elastic swelling of the body, crepitating under the touch.

M. M. Scarifications, compresses, tonics.

Genus II. *Tympanites,* a windy swelling of the abdomen, tense, elastic, painful, and attended by costiveness.

Tympanitic swellings often take place in conjunction with anasarca, or other disorders of debility, and frequently arise from sedentary habits, hypochondriac ailments, and innutritious diet.

M. M. Carminatives, emetics, tonics, and a generous diet, with exercise.

Genus III. *Physometra,* an elastic swelling in the hypogastrium, consequent upon flatulent distension of the womb.

This frequently deceives the barren female with the hopes of pregnancy, till nature explains the mystery, and her expectations vanish in air.

Sect. III. *Aquosæ.* Watery swellings.

Dropsical enlargement is distinguished from pneumatosis by its being inelastic, or pitting from the pressure of the finger, and slowly recovering its former fulness. Dropsy is a collection of serous fluid, either in the cellular membrane, or in the cavities of the body. It is invariably occasioned by exhalation being disproportionate to absorption; this increase of exhalation and diminution of absorption result from debility, which may be either direct or indirect; the latter follows increased action of the vessels, as in the dropsy succeeding to intemperance; the former arises out of deficient excitement in the lymphatic system, as when an individual becomes dropsical from indolence, inactivity, mental depression, and poverty of diet.

Genus I. *Anasarca.* General dropsy.

Dropsy of the cellular membrane immediately under the skin appears principally in the lower extremities, on account of the depending situation of these members, and the universal connection between the cells of which the membrane is constituted. Anasarca, as it arises from exhausted excitability in the lymphatic

vessels, is always a disorder indicating much danger.

M. M. Those stimuli which are found to exert their influence on the absorbent vessels, particularly steel, digitalis, calomel. Diuretic, such as squills, juniper, nitrous æther, cantharides, chrystals of tartar, and nitre. Emetics and cathartics are less proper in anasarca than in dropsy of cavities. The physician must be especially careful while evacuating the fluid by means of diuretics, to support the general excitement, in order to prevent its reaccumulation. The sparing use of liquids is generally proper in dropsy; instances, however, have been known of copious draughts of water producing a termination of the complaint.

Genus II. *Hydrocephalus,* dropsy of the brain.

Genus III. *Hydrorachitis,* dropsical tumour in the spine.

Genus IV. *Hydrothorax,* dropsy of the chest.

Symptoms. Difficulty of breathing, especially in a horizontal position, paleness of countenance, starting in sleep, palpitation of the heart, numbness of the arms, especially when elevated, and in the advanced stages of the malady an evident fluctuation of water in the cavity of the chest.

Causes. Where the universal has preceded the local affection, the malady is most frequently to be traced to intemperance in the use of fermented and spirituous liquors. The most usual source of genuine hydrothorax, or hydrops pectoris, is the sudden application of cold, while the body is in a state of perspiration and debility, from previous heat and exercise.

M. M. Digitalis in considerable doses is especially indicated in dropsy of the chest. Squill, in combination with calomel, for the hydrops pectoris; and if the cellular membrane be anasarcous, connect steel with both the above medicines. Chrystals of tartar, especially in the anasarca pulmonum. Diuretics of other kinds, the same as in general anasarca. Opium. In hydrothorax, or dropsy of the chest, without anasarca, paracentesis, or puncture in the side.

Genus V. *Ascites.* Dropsy of the abdomen. The swelling of the abdomen is tense, scarcely elastic, but fluctuating. Ascites is attended with scarcity of urine, thirst, and after some time a degree of hectic fever. Ascites most usually originates through the medium of a diseased liver; and such disease is, in the greater number of instances, itself induced by intemperance in spirituous liquors.

M. M. If the water is independant of disease in the liver, chrystals of tartar, digitalis, other diuretics, and steel, may be immediately had recourse to, without the intervention of calomel purgatives and of emetics, which last are almost always indicated in the more usual form of ascites, that form a morbid affection of the biliary organs. Emetics in hepatic ascites are often attended with most beneficial effects. A combination of gamboge, elaterium, and calomel, is frequently employed as a purgative in ascites. Mercurial ointment to the region of the liver. Tonics, especially steel.

Genus V. *Hydrometria.* Dropsy of the womb. It is characterized by dropsical swelling, confined to the region of the uterus, not being accompanied by other symptoms of dropsy. It is a disease to which the unmarried and the barren are principally obnoxious; sometimes it follows abortion.

M. M. Stimulant fomentations. Drastic purgatives. Aromatic fœtid gums. Emmenagogues.

SECT IV. *Solidæ.* Swellings of solid parts.

Genus I. *Physconia.* A swelling chiefly occupying a portion of the abdomen, increasing gradually, and neither tense nor sonorous as in pneumatosis, nor fluctuating as in dropsy. This disease is principally formed by a schirrous state of the several parts and viscera, which form its seat. These schirrous enlargements are generally incurable.

Genus II. *Rachitis.* Rickets.

ORDER III. *Impetigines,*

Deformities and discolourations of the external surface from general disease.

Genus I. *Scrophula.* King's evil.

Swellings of the lymphatic glands, terminating in ulcer, are perhaps the only proper characteristics of actual scrophula. A scrophulous habit is merely a susceptibility of disease, arising from torpor in the lymphatic vessels, and when brought on by the agency of exciting causes, consists in a peculiar action of the lymphatic glands, by which inflammation and at length ulceration, with a discharge of grumous matter, are induced. Its exciting causes are those which encourage the original debility, and the disease may almost certainly be avoided by attention to diet and regimen; by nutritious food, a pure oxygenous atmosphere, cleanliness, exercise, &c. When by neglect, the predisposition has been permitted to break out into disease, calomel purges, steel, small doses of digitalis, warm and sea-bathing, muriates and phosphates of barytes; above all cleanliness; ventilation, stimulating nutritious diet. Let the mind be preserved free from the erroneous idea, that to cure scrophula is to purge away gross humours.

Genus II. *Syphilis.* Venereal disease.

After impure connection, a disorder of the genitals, ulcers in the mouth and nose Eruptions on the skin of a copper colour, terminating in ulceration; these are principally situated near the margin of the hair; blotches on the surface of the body, especially on the surface of the face. Nocturnal pains in the centre of the bones.

M. M. Mercurials. Nitric acid. Tonics.

Genus III. *Scorbutus,* scurvy.

Indolence and lassitude; gloomy and tumid countenance; gums livid, and disposed to bleed spontaneously, or from the slightest irritation; skin dry, and covered with livid spots; œdematous swellings of the ancles. Scurvy appears to originate from want of, or exhausted excitement, both in the venous and absorbent system; it is produced by a protracted course of salt food, and by mental depression.

M. M. Fresh animal and vegetable diet. Juice of lemon. Bark. Steel. Terrene atmosphere. Mental excitement.

The elephantiasis, lepra, frambæsia, and trichoma, forming the fourth, fifth, sixth, and seventh genera of this order, are diseases of such rare occurrence in this country, as not to require any particular description.

Genus III. *Icterus*, jaundice

Symptoms. Yellowness of the skin and eyes; white and slimy fæces: high-coloured urine, tinging linen yellow; languor, lassitude, and extreme depression of spirits. The yellow colour of the skin, which constitutes jaundice, arises from the diffusion through the system of that bile, which, in the natural course, would pass through the biliary ducts into the intestinal canal. This interruption of the biliary secretion may originate from a spasmodic affection near the duct; from chronic inflammations, or other diseases of the liver interfering with the secretion; from certain concretions lodging in some part of the he[illegible]ic organs, called gall-stones; and, as pointed out by Mr. Townsend, from viscid mucus stopping up or obstructing the biliary passages.

The first of the above species of jaundice is generally of a temporary nature. The second species follows upon a long course of intemperance in spirituous [illegible]quors, and is only to be remedied by removing the disease of the liver itself. The biliary calculi, which give rise to the third species of jaundice, appear to arise from some defective action in the secretory or absorbing vessels of the parts in which they are formed or lodged. Their presence may be ascertained from jaundice frequently disappearing and returning, from the appearance of biliary concretions among the fæces, and from the disease being attended with shooting pains in the epigastric region, and right hypochondrium. Nausea, difficult respiration, and sickness, often likewise accompany this species of jaundice. The mucosus is unattended either by pain or spasmodic affections; there are no gall-stones observed in the fæces; but these are generally discharged mixed with much slime and viscidities. It is generally accompanied with, and most commonly occasioned by, a depression of mind, especially when favoured by sedentary habits, breathing an impure atmosphere, living upon unwholesome innutritious diet, or indulging in the too free use of "spirituous potation."

M. M. Emetics. Calomel purgatives. Bitter. Tonics, especially colombo, with rhubarb. Pure air. Exercise on horseback. Mental excitement. In icterus spasmodicus, opium, assafœtida, æther, electricity. If the spasm depends upon any irritations in the stomach or bowels, these to be removed by emetics, purgatives, anthelmintics. In icterus calculosus, emetics to facilitate the passage of the gall-stones. Antispasmodics, Warm bathing. Emollient clysters. Vegetable tonics, and steel.

MEDIETAS LINGUÆ, a jury or inquest impanelled, whereof the one-half consists of natives or denizens, the other strangers; and used in pleas wherein the one party is a stranger, the other a denizen.

MEDIUM, in logic, the mean or middle term of a syllogism, being an argument, reason, or consideration, for which we affirm or deny any thing; or, it is the cause why the greater extreme is affirmed or denied of the less in the conclusion.

MEDIUM, or MEAN, *geometrical*. See MEAN.

MEDIUM, in philosophy, that space or region through which a body in motion passes to any point; thus æther is supposed to be the medium through which the heavenly bodies move; air, the medium wherein bodies move near our earth: water, the medium wherein fishes live and move; and glass is also a medium of light as it affords it a free passage. That density or consistence in the parts of the medium, whereby the motion of bodies in it is retarded, is called the resistance of the medium, which together with the force of gravity, is the cause of the cessation of the motion of projectiles.

MEDUSA, a genus of vermes of the order mollusca. The animals of this genus consist of a tender gelatinous mass of different figures, furnished with arms or tentacular processes, proceeding from the lower surface: the larger species, when touched, cause a slight tingling and redness, and are usually denominated sea-nettles; they are supposed to constitute the chief food of cetaceous fish, and most of them shine with great splendour in the water. There are 44 species.

MEERSCHAUM. Keffekil of Kirwan. Colours, yellowish and greyish-white. Massive. Dull. Fracture fine earthy. Fragments angular. Opaque. Streak slightly shining. Does not soil. Very soft, sectile, but rather difficultly frangible. Adheres strongly to the tongue. Feels rather greasy. Sp. gr. 1.2 to 1.6. Before the blowpipe, it melts on the edges into a white enamel. Its constituents are, silica 41.5, magnesia 18.25, lime 0.50, water and carbonic acid 39.—*Klaproth.* It occurs in the veins in the serpentine of Cornwall. When first dug, it is soft, greasy, and lathers like soap. Hence the Tartars use it for washing clothes. In Turkey it is made into tobacco pipes, from meerschaum dug in Natolia, and near Thebes.

MELANITE. Colour, velvet-black. In roundish grains, but more frequently crystallized in a rhomboidal dodecahedron, truncated on all the edges. Surface of the grains rough and uneven; that of the crystals shining. Fracture flat conchoidal. Opaque. As hard as quartz. Rather easily frangible. Sp. gr. 3.73. Its constituents are, silica 35.5, alumina 6, lime 32.5, oxide of iron 25.25, oxide of manganese 0.4, loss 0.35. It is found in a rock at Frescati near Rome, and in the basalt of Bohemia.

MELALEUCA, a genus of the polyandria order, belonging to the polyadelphia class of plants. The species are 11, natives of India and the South-sea islands. The most remarkable is the leucadendron, from a variety of which the cajeput oil is obtained; a medicine in very high esteem among the Eastern nations, particularly in India. It is said to be obtained by distillation from the fruit of the tree. It is applied externally where a warm and peculiar stimulus is requisite; it is employed for restoring vigour after luxations and sprains, and for easing a violent pain in gouty and rheumatic cases, in tooth-ache, and similar affections.

MELAMPYRUM, *cow-wheat*, a genus of the angiospermia order, in the didynamia class of plants, and in the natural method ranking under the 40th order, personatæ. There are five species, four of them natives of Britain, and growing spontaneously among corn-fields. They are excellent food for cattle; and Linnæus says, that where they abound, the yellowest and best butter is made.

MELEAGRIS, in ornithology, the turkey, a genus of birds belonging to the order of gallinæ. The head is covered with spongy

caruncles; and there is likewise a membranaceous longitudinal caruncle on the throat. There are but two species, viz. the gallopavo, or North American turkey of Ray; and the satyra, or horned turkey. The first has a caruncle both on the head and throat; and the breast of the male is bearded or tufted. It lives upon grain and insects; when the cock struts, he blows up his breast, spreads and erects his feathers, relaxes the caruncle on the forehead, and the naked parts of the face and neck become intensely red. The turkey hen begins to lay early in the spring, and will often produce a great number of eggs, which are white, marked with reddish or yellow spots, or rather freckles. She sits well, and is careful of her young; of which she will often have from 14 to 17 for one brood: but she scarcely ever sits more than once in a season. Turkeys are bred in quantities in some of the eastern counties of England, and are driven up to London towards autumn for sale in flocks of several hundreds, which are collected from the several cottages about Norfolk, Suffolk, and neighbouring counties, the inhabitants of which think it well worth their while to attend carefully to them, by making these birds a part of their family during the breeding-season.

MELIANTHUS, *honey-flower*, a genus of the angiospermia order, in the didynamia class of plants, and in the natural method ranking under the 24th order, corydales. The calyx is pentaphyllous, with the lowermost leaf gibbous: there are four petals, with the nectarium under the lowest ones. The capsule is quadrilocular. There are three species.

MELISSA, *baum*, a genus of the didynamia gymnospermia class of plants. There are six species.

Baum is greatly esteemed among the common people as good in disorders of the head and stomach; but is less regarded in the shops. It is most conveniently taken in infusion by way of tea; the green herb is greatly better than the dry, which is contrary to the general rule in relation to other plants.

MELLATES, in chemistry, are compounds, of mellitic acid with the salifiable bases.

MELLITE, *honeystone, mellat of alumina.* This mineral was first observed about 10 years ago in Thuringia, between the layers of wood coal. It is of a honey-yellow colour, and is usually crystallized in small octahedrons. Fracture conchoidal. Specific gravity from 1.5 to 1.7. When heated it whitens, and in the open air burns without being sensibly charred. A white matter remains, which effervesces slightly with acids, and which at first has no taste, but at length leaves an acid impression upon the tongue.

MELLITIC *acid,* in chemistry, is procured from the substance just described, by the following process. The mineral is reduced to powder, and boiled with about 72 times its weight of water; the alumina is precipitated in the form of flakes, and the acid combines with the water. By filtration and evaporation, crystals are deposited, which are the crystals of mellitic acid; they are in the form of fine needles, or in small short prisms with shining faces; they have a slightly acid taste, accompanied with some degree of bitterness. This acid is not very soluble in water; its constituent parts are carbon, hydrogen, and oxygen. The acid enters into combination with the earths, alkalis, and metallic oxides, and forms compounds denominated mellates.

MELOCHIA, *Jew's mallow,* a genus of the pentandria order, in the monadelphia class of plants, and in the natural method ranking under the 37th order, columniferæ. The capsule is quinquelocular and monospermous. There are 11 species: but the only remarkable one is the olitorous, or common Jew's mallow, which is a native of the warm parts of Asia and America. It is an annual plant. This species is cultivated about the city of Aleppo in Syria, and in the East Indies, as a pot-herb; the Jews boiling the leaves, and eating them with their meat.

MELODY, in music, the agreeable effect of different sounds, ranged and disposed in succession; so that melody is the effect of a single voice or instrument, by which it is distinguished from harmony.

MELOE, a genus of insects of the order coleoptera: the generic character is: antennæ moniliform, with the last joint ovate; thorax roundish; wing-sheaths soft, flexile; head inflected. Among the principal species of meloe may be numbered the meloe proscarabæus, commonly called the oil-beetle. It is of considerable size, often measuring near an inch and a half in length; its colour is violet-black, especially on the antennæ and limbs; the wing-sheaths are very short, in the female insect especially, scarcely covering more than a third of the body, and are of an oval shape. On being handled it suddenly exsudes from the joints of its legs, as well as from some parts of the body, several drops of a clear deep-yellow oil or fluid, of a very peculiar and penetrating smell. This oil or fluid has been highly celebrated for its supposed efficacy, in rheumatic pains, &c. when used as an embrocation on the parts affected; for this purpose also the oil expressed from the whole insect has been used with equal success.

The *meloe scabrosus* extremely resembles the preceding, and is found in similar situations, but differs in being of a reddish purple colour, with a cast of deep gilded green.

Meloe vesicatorius, blister-fly, or Spanish fly, is an insect of great beauty, being entirely of the richest gilded grass-green, with black antennæ.

MELON. See CUCUMIS.

MEMORY, is that faculty of the human mind by which it retains the ideas it has once acquired. Memory, says Mr. Locke in his Essay on the Human Understanding, is, as it were, the store-house of our ideas; for the narrow mind of man not being capable of having many ideas under view at once, it was necessary to have a repository in which to lay up those ideas which it may afterwards have use of. But our ideas being nothing but actual perceptions in the mind, which cease to be any thing when there is no perception of them; this laying up of our ideas in the repository of the memory, signifies no more than this; that the mind has a power in many cases, to revive perceptions it has once had, with this additional perception annexed to them, that it has had them before. And it is by the assistance of this faculty, that we are said to have all those ideas in our understandings which we can bring in sight, and make the object of

our thoughts, without the help of those sensible qualities which first imprinted them there. Attention and repetition help much to the fixing ideas in our memories; but those which make the deepest and most lasting impressions, are those which are accompanied with pleasure and pain. Ideas but once taken in and never again repeated, are soon lost; as those of colours in such as lost their sight when very young. The memory of some men is tenacious almost to a miracle; but yet there seems to be a constant decay of all our ideas, even of those which are struck deepest; and in minds the most retentive. Those ideas that are often refreshed by a frequent return of the objects or actions that produce them, fix themselves best in the memory, and remain longest there: such are the original qualities of bodies. In memory, the mind is oftentimes more than barely passive; for it often sets itself on work to search some hidden ideas; sometimes they start of their own accord; and sometimes tempestuous passions tumble them out of their cells. This faculty other animals seem to have to a great degree, as well as man.

Memory, *artificial*, a method of assisting the memory by forming certain words, the letters of which shall signify the date or æra to be remembered. In order to this, the following series of vowels, diphthongs, and consonants, together with their corresponding numbers, must be exactly learned, so as to be able at pleasure to form a technical word, that shall stand for any number, or to resolve such a word already formed.

a	*e*	*i*		*u*	*au*	*oi*	*ei*	*ou*	*y*
1	2	3		5	6	7	8	9	0
b	*d*	*t*		*l*	*s*	*p*	*k*	*n*	*z*

The first five vowels, in order, naturally represent 1, 2, 3, 4, 5, the diphthong *au* = 6, as being composed of *a* and *u*, or 1 + 5 = 6: and for the like reason, *oi* = 7, and *ou* = 9. The diphthong *ei* will easily be remembered for 8, as being the initials of the word. In like manner, where the initial consonants could conveniently be retained, they are made use of to signify the number, as *t* for 3, *f* for 4, *s* for 6, and *n* for 9. The rest were assigned without any particular reason, unless that possibly *p* may be more easily remembered for 7, or septem, *k* for 8, or ὀκτώ, *d* for 2, or duo; *b* for 1, as being the first consonant; and *l* for 5, being the Roman letter for 50; than any others that could have been put in their places.

It is further to be observed, that *z* and *y* being made use of to represent the cypher, where many cyphers meet together, as 1000, 1000000, &c. instead of a repetition of *a z y z y z y*, &c. let *g* stand for 100, *th* for a thousand, and *m* for a million. Thus *ag* will be 100, *ig* 300: *oug* 900, &c. *ath* 1000, *am* 1000000, *loum* 59000000, &c.

Fractions may be set down in the following manner: let *r* signify the line separating the numerator and denominator the first coming before, the other after it; as *iro* $\frac{3}{4}$, *urp* $\frac{5}{7}$, *pourag* $\frac{79}{100}$, &c. When the numerator is 1 or unit, it need not be expressed, but begin the fraction with *r*; as *re*, $\frac{1}{2}$ *ri* $\frac{1}{3}$, *ro* $\frac{1}{4}$, &c. So in decimals, *rag* $\frac{1}{100}$, *rath* $\frac{1}{1000}$.

This is the principal part of the method which consists in expressing numbers by artificial words. The application to history and chronology is also performed by artificial words. The art herein consists in making such a change in the ending of the name of a place, person, planet, coin, &c. without altering the beginning of it, as shall readily suggest the thing sought, at the same time that the beginning of the word being preserved, shall be a leading or prompting syllable to the ending of it so changed. Thus, in order to remember the years in which Cyrus, Alexander, and Julius Cæsar, founded their respective monarchies, the following words may be formed; for Cyrus, Cyr*uts*; for Alexander, Alex*ita*; for Julius Cæsar, Juli*os*. *Uts* signifies, according to the powers assigned to the letters before-mentioned 536; *ita* is 331; and *os* is 46. Hence it will be easy to remember, that the empire of Cyrus was founded 536 years before Christ, that of Alexander 331, and that of Julius Cæsar 46.

This account is taken from a treatise, entitled, a New Method of Artificial Memory; where the reader will find several examples in chronology, geography, &c. of such artificial words disposed in verses, which must be allowed to contribute much to the assistance of the memory, since being once learned, they are seldom or never forgotten. However, the author advises his reader to form the words and verses himself in the manner described above, as he will probably remember these better than those formed by another.

We shall, in this place, give his table of the kings of England since the Conquest, where one thousand being added to the italics in each word, expresses the year when they began their reigns. Thus,

Will con*sau*, Rul*koi*, Hen*ray*.
Steph*bil* and Hensec*buf*, Rich*bein*, Ja*nn*,
Heth*das* and Ed*doid*.
Edse*typ*. Edter*tep*, Rise*tois*, Hefo*toun*,
Hefi*sadque*.
Henfi*led*, Edquar*fauz*, Efi-Ro*kt*, Hensep*feil*,
Henoc*lyn*.
Edsex*los*, Mary*lut*, Els*luk*, Jam*syd*, Caro
primse*l*,
Casse*sok*, Jam*seif*, Wil*seik*, An*pyd*, Geo-
bo-doi.

MENDICANTS, or begging friars, several orders of the religious in popish countries, who, having no settled revenue, are supported by charitable contributions.

MENISCUS. See Optics.

MENISPERMUM, a genus of the diœcia dodecandria class and order. There are 13 species, herbs of the East Indies.

MENNONITES, a sect of baptists in Holland, so called from Mennon Simonis of Friezland, who lived in the sixteenth century. This sect believed that the New Testament is the only rule of faith; that the terms person and trinity are not to be used in speaking of the Father, Son, and Holy Ghost; that the first man was not created perfect; that it is unlawful to swear or to wage war upon any occasion; that infants are not proper subjects of baptism: and that ministers of the gospel ought to receive no salary.

MENSTRUUM, in chemistry the fluid in which a solid body is dissolved.

MENSURATION, in general, denotes the act or art of measuring lines, superfices, and solids; and it is, next to arithmetic, a

subject of the greatest use and importance, both in affairs that are absolutely necessary in human life, and in every branch of mathematics; a subject by which sciences are established, and commerce is conducted; by whose aid we manage our business, and inform ourselves of the wonderful operations in nature; by which we measure the heavens and the earth, estimate the capacities of all vessels and the bulks of all bodies, gauge our liquors, build edifices, measure our lands and the works of artificers, buy and sell an infinite variety of things necessary in life, and are supplied with the means of making the calculations which are necessary for the construction of almost all machines. To offer here a general view of this subject would very much exceed our bounds; the leading principles will be found developed under other articles of which, we must take more ample notice; and as our object is not to thrust in matter for the sake of swelling our pages, but to give the reader as great a variety of useful information as possible, we must refer him to those articles. See NAVIGATION, SURVEYING, and TRIGONOMETRY.

MENTHA, mint, a genus of the gymnospermia order, in the didynamia class of plants; and in the natural method ranking under the 42d order, verticillatæ. There are 19 species; but not more than three are cultivated for use, namely, the viridis, or common spearmint, the piperita or peppermint, and the pulegium or pennyroyal. All these are so well known as to need no description; and all of them are very easily propagated by cuttings, parting the roots, or by offsets. For culinary purposes, the spearmint is preferred to the other two; but for medicine, the peppermint and pennyroyal have almost entirely superseded it.

The virtues of mint are those of a warm stomachic, capable of relieving colicky pains, and the gripes, to which children are subject. It likewise proves a useful cordial in languors and faintness. Pennyroyal has the same general characters with the mint, but is more acrid and less agreeable when taken into the stomach.

MENYANTHUS, buckbean, a genus of the pentandria monogynia class of plants, with a monopetalous funnel-like flower, divided into five deep segments at the limb; the fruit is an oval capsule with one cell, containing a great many small seeds. There are five species.

MERCHANT, a person who buys and sells commodities in gross, or deals in exchanges; or that traffics in the way of commerce, either by importation or exportation. Formerly every one who was a buyer or seller in the retail was called a merchant, as they are still both in France and Holland, and in some parts of Scotland; but in England shopkeepers, or those who attend fairs or markets, have lost that appellation.

The following epitome of the qualifications requisite in a merchant, are well deserving the serious attention of every youth who has the prospect of being employed in commercial transactions. A merchant should therefore be acquainted with the following parts of commercial learning: 1. He should write properly and correctly. 2. Understand all the rules of arithmetic that have any relation to commerce. 3. Know how to keep books of double and single entry, as journals, a ledger, &c. 4 Be expert in the forms of invoices, accounts of sales, policies of insurance, charter-parties, bills of lading, and bills of exchange. 5. Know the agreement between the money, weights, and measures of all parts. 6. If he deals in silk, woollen, linen, or hair manufactures, he ought to know the places where the different sorts of merchandizes are manufactured, in what manner they are made, what are the materials of which they are composed, and from whence they come, the preparation of these materials before working up, and the places to which they are sent after their fabrication. 7. He ought to know the lengths and breadths which silk, woollen, or hair-stuffs, linen, cottons, fustians, &c. ought to have, according to the several statutes and regulations of the places where they are manufactured, with their different prices, according to the times and seasons; and if he can add to his knowledge the different dyes and ingredients which form the various colours, it will not be useless. 8. If he confines his trade to that of oils, wines, &c. he ought to inform himself particularly of the appearance of the succeeding crops, in order to regulate his disposing of what he has on hand, and to learn as exactly as he can, what they have produced when got in, for his director in making the necessary purchases and engagements. 9. He ought to be acquainted with the sorts of merchandise found more in one country than another, those which are scarce, their different species and qualities, and the properest method of bringing them to a good market. 10. To know which are the merchandises permitted or prohibited, as well on entering as going out of the kingdoms or states were they are made. 11. To be acquainted with the price of exchange, and what is the cause of its rise and fall. 12. To know the customs, due on importation of merchandises, in the places to which he trades. 13. To know the best maner of folding up, embaling, or turning the merchandises. 14. To understand the price and condition of freighting, and insuring ships and merchandize. 15. To be acquainted with the goodness and value of all necessaries for the construction, repairs, and fitting out of shipping; with the different manner of their building. 16. To know the wages commonly given to the captains, officers and sailors, and the manner of engaging with them. 17. He ought to understand foreign languages, particularly the French, Spanish, Italian, and German. 18. He ought to be acquainted with the consular jurisdiction, with the laws and customs of the different countries, and in general all the ordinances and regulations both at home and abroad that have any relation to commerce.

A material requisite for forming a merchant is, his having on all occasions a strict regard to truth, and his avoiding fraud and deceit as corroding cankers, that must inevitably destroy his reputation and fortune. Trade is of so universal a nature that it is impossible for the laws of one country to determine all the affairs relating to it; therefore all nations, as well as Great Britain, shew a particular regard to the LAW MERCHANT, which is a law made by the merchants among themselves: however, merchants and other strangers are subject to the laws of the country in which they reside.

MERCURIALIS, *mercury*, a genus of the enneandria order, in the diœcia class of plants, and in the natural method ranking under the 38th order, tricoccæ. There are six species. Of these, the *perennis*, according to Mr. Lightfoot, is of a sophorific deleterious nature, noxious both to man and beast.

MERCURY is distinguished from all other metals by its extreme fusibility, which is such, that it does not take the solid state until cooled to the thirty-ninth degree below 0 on Fahrenheit's thermometer; and of course it is always fluid in the temperate climates of the earth. Its colour is white, and rather bluer than silver. In the solid state it is malleable; its specific gravity is 13.6. It is volatile, and rises in small portions at the common temperature of the atmosphere, as is evinced by several experiments, more especially in a vacuum, such as obtains in the upper part of a barometer tube. At the temperature of about 656° it boils rapidly, and rises copiously in fumes. When exposed to such a heat as may cause it to rise quickly in the vaporous form, or about 600°, it gradually becomes converted into a red oxide, provided oxygen be present. This was formerly known by the name of precipitate *per se*. A greater heat, however, revives this metallic oxide, at the same time that the oxygen is again extricated. Ten days, or a fortnight's constant heat is required to convert a few grains of mercury into precipitate *per se* in the small way. From this volatility of mercury, it is commonly purified by distillation.

Mercury is not perceptibly altered by mere exposure to the air; though by long agitation, with access of air, it becomes converted into a black powder or oxide, which gives out oxygen by heat, the metal being at the same time revived.

Mercury being habitually fluid, very readily combines with most of the metals, to which it communicates more or less of its fusibility. When these metallic mixtures contain a sufficient quantity of mercury to render them soft at a mean temperature, they are called *amalgams*.

It very readily combines with gold, silver, lead, tin, bismuth, and zinc; more difficultly with copper, arsenic and antimony; and scarcely at all with platina or iron: it does not unite with nickel, manganese, or cobalt; and its action on tungsten and molybdena is not known. Looking-glasses are covered on the back surface with an amalgam of tin. See Silvering.

The amalgamation of the noble metals, water-gilding, the making of vermilion, the silvering of looking-glasses, the making of barometers and thermometers, and the preparation of several powerful medicines, are the principal uses to which this metal is applied.

Scarcely any substance is so liable to adulteration as mercury, owing to the property which it possesses of dissolving completely some of the baser metals. This union is so strong, that they even rise along with the quicksilver when distilled. The impurity of mercury is generally indicated by its dull aspect; by its tarnishing, and becoming covered with a coat of oxide, on long exposure to the air; by its adhesion to the surface of glass; and when shaken with water in a bottle, by the speedy formation of a black powder. Lead and tin are frequent impurities and the mercury becomes capable of taking up more of these, if zinc or bismuth be previously added. In order to discover lead, the mercury may be agitated with a little water, in order to oxidize that metal. Pour off the water, and digest the mercury with a little acetic acid. This will dissolve the oxide of lead, which will be indicated by a blackish precipitate with sulphuretted water.

A fulminating preparation of mercury was discovered by Mr. Howard. A hundred grains of mercury are to be dissolved by heat in an ounce and a half by measure of nitric acid. This solution being poured cold into two ounces by measure of alcohol in a glass vessel, heat is to be applied till effervescence is excited. A white vapour undulates on the surface, and a powder is gradually precipitated, which is immediately to be collected on a filter, well washed, and cautiously dried with a very moderate heat. This powder detonates loudly by gentle heat, or slight friction.

Red oxide of mercury is acrid and poisonous, and carries these qualities into its saline combinations. The protoxide is relatively bland, and is the basis of all the mild mercurial medicines.

Mercury, in astronomy, the smallest of the planets, and the nearest the sun. See Astronomy.

MERGUS, in ornithology, a genus of birds of the order of anseres; distinguished by having the beak of a cylindrical figure, and hooked at the extremities, and its denticulations of a subulated form.

1. The *cucullatus*, or crested diver of Catesby, has a globular crest, white on each side; and the body is brown above, and white below. This elegant species inhabits North America. It appears at Hudson's bay the end of May, and builds close to the lakes.

2. The *merganser*, or goosander, weighs four pounds; its length is two feet four inches; the breadth three four. The dun-diver, or female, is less than the male; the head and upper part of the neck are ferruginous; the throat white; the feathers on the hind parts are long, and form a pendant crest: the back, the coverts of the wings, and the tail are of a deep ash-colour; the greater quill-feathers are black, the lesser white; the breast and middle of the belly are white, tinged with yellow. The goosander seems to prefer the more northern situations to those of the south.

3. The *albellus*, or smew, weighs about 34 ounces; the length is 18 inches, the breadth 26; the bill is near two inches long, and of a lead colour; the head is adorned with a long crest, white above and black beneath; the head, neck, and whole under part of the body, are of a pure white; the tail is of a deep ash-colour, the legs a blueish grey. The female, or lough-diver, is less than the male; the back, the scapulars, and the tail, are dusky; the belly is white. There are three other species.

MERIDIAN. See Astronomy, and Geography.

Meridian *line*, on a dial, is a right line arising from the intersection of the meridian of the place, with the plane of the dial.

Meridian, *magnetical*, is a great circle passing through the magnetic poles, to which the magnetic needle, or needle of the mariner's compass, conforms itself.

MERIDIONAL distance, in navigation, is the same with the departure, easting or westing, or the difference of longitude between the meridian under which the ship now is, and any other meridian she was before under.

Meridional parts. See Navigation.

MERLIN. See Falco.

MERLON, in fortification, that part of a parapet which is terminated by two embrasures of a battery. Its height and thickness is the same with that of the parapet; but its breadth is generally nine feet on the inside, and six on the outside. It serves to cover those on the battery from the enemy; it should be made of earth well beat and close.

MEROPS, a genus of birds of the order picæ. Generic character: bill quadrangular, somewhat curved, compressed, and pointed; nostrils small, at the base of the bill; tongue slender, and in some species ciliated, the outer toe somewhat connected with the middle one. Gmelin notices twenty-six species and Latham twenty. M. apiaster, or the common bee-eater; this is about ten inches long, and found in many countries of Europe, though never observed in Great Britain. It is particularly fond of bees, but will eat various other insects; many of which it seizes, like the swallow, on the wing. When insects are with difficulty to be found, it feeds on many species of seeds.

MESENTERY. See Anatomy.

MESNE, he who is lord of a manor, and so has tenants holding of him, yet himself, holds of a superior lord.

MESNE PROCESS, is an intermediate process, which issues pending the suit, upon some collateral interlocutory matter, as to summon juries, witnesses, and the like: sometimes it is put in contradistinction to final process, or process of execution; and then it signifies all such process as intervenes between the beginning and end of a suit.

MESPILUS, in botany, a genus of the icosandria pentagynia class and order. Natural order of pomaceæ. Calyx five cleft, petals five; berry inferior, five seeded. There are nine species. M. germanica, Dutch or common medlar, never rises with an upright trunk, but sends out crooked deformed branches, not far from the ground: leaves large, entire, downy on their under side; flowers very large, as also the fruit, which approaches to the shape of an apple. The tree bearing the largest fruit is now generally cultivated; the Nottingham medlar, has a more poignant taste, but the fruit is considerably less.

MESSENGERS, are certain officers chiefly employed under the direction of the secretaries of state, and always in readiness to be sent with all kinds of dispatches foreign and domestic. They also, by virtue of the secretaries' warrants, take up persons for high treason, or other offences against the state.

METALS. The most numerous class of undecompounded chemical bodies, distinguished by the following general characters:—

1. They possess a peculiar lustre, which continues in the streak, and in their smallest fragments.

2. They are fusible by heat; and in fusion retain their lustre and opacity.

3. They are all, except selenium, excellent conductors both of electricity and caloric.

4. Many of them may be extended under the hammer, and are called malleable; or under the rolling press, and are called laminable; or drawn into wire, and are called ductile. This capability of extension depends, in some measure, on a tenacity peculiar to the metals, and which exists in the different species with very different degrees of force. See Cohesion.

5. When their saline combinations are electrized, the metals separate at the resino-electric or negative pole.

6. When exposed to the action of oxygen, chlorine, or iodine, at an elevated temperature, they generally take fire, and, combining with one or other of these three elementary dissolvents in definite proportions, are converted into earthy or saline looking bodies, devoid of metallic lustre and ductility, called oxides, chlorides, or iodides.

7. They are capable of combining in their melted state with each other, in almost every proportion, constituting the important order of metallic alloys; in which the characteristic lustre and tenacity are preserved. See Alloy.

8. From this brilliancy and opacity conjointly, they reflect the greater part of the light which falls on their surface, and hence form excellent mirrors.

9. Most of them combine in definite proportions with sulphur and phosphorus, forming bodies frequently of a semi-metallic aspect; and others unite with hydrogen, carbon, and boron, giving rise to gaseous or solid compounds.

10. Many of the metals are capable of assuming, by particular management, crystalline forms; which are, for the most part, either cubes or octohedrons. See Chemistry.

Metal, in heraldry. There are two metals used in heraldry, by way of colours, viz. gold and silver, in blazon called *or* and *argent*. In the common painting of arms these metals are represented by white and yellow, which are the natural colours of those metals. In engraving, gold is expressed by dotting the coat, &c. all over; and silver, by leaving it quite blank.

METALLURGY, comprehends the whole art of working metals from the state of ore to the utensil; hence, assaying, gilding, refining, smelting, &c. are only branches of metallurgy. In a more limited sense, it includes only the operations which are followed in separating metals from their ores. See Assaying, &c.

METAPHOR, in rhetoric, a trope, by which we put a strange word for a proper word, by reason of its resemblance to it; or it is a simile or comparison intended to enforce and illustrate the thing we speak of, without the signs or forms of comparison.

METAPHYSICS. See Philosophy.

METATARSUS. See Anatomy.

METEOR. This term is by some writers made to comprehend all the visible phenomena of meteorology, but it is more generally confined to luminous bodies appearing suddenly at uncertain times, and with more or less of motion in the atmosphere. These may be reduced under three classes, viz. fire-balls, falling or shooting stars, and ignes fatui

Those phenomena which are classed together under the general appellation of fire-balls, were divided by the ancients into several species, according to the external form or appearance which they assumed. In tropical climates these meteors are more common and more stupendous than in these more temperate regions.

Two meteors appeared in England in the year 1783, of which a most particular account and ingenious solution, by Dr. Blagden, are published in the Philosophical Transactions of the following year. The first of these was seen on the 18th of August, and was, in appearance, a luminous ball, which rose in the N. N. W. nearly round: it, however, soon became elliptical, and gradually assumed a tail as it ascended, and, in a certain part of its course, seemed to undergo a remarkable change, compared to bursting; after which it proceeded no longer as an entire mass, but was apparently divided into a cluster of balls of different magnitudes, and all carrying or leaving a train behind, till, having passed the east, and verging considerably to the south, it gradually descended, and was lost out of sight. The time of its appearance was about sixteen minutes past nine in the evening, and it was visible about half a minute. It was seen in all parts of Great Britain, at Paris, at Nuits in Burgundy, and even at Rome: and is supposed to have described a tract of 1000 miles at least over the surface of the earth. The illumination of these meteors is often so great as totally to obliterate the stars, to make the moon look dull, and even to affect the spectators like the sun itself. The body of the fire-ball, even before it burst, did not appear of an uniform brightness, but consisted of lucid and dull parts, which were constantly changing their respective positions, so that the whole effect was to some eyes like an internal agitation or boiling of the matter. By the best accounts that could be procured concerning the height of the meteor, it seems to have varied from 55 to 60 miles. A report was heard some time after the meteor disappeared, and this report was loudest in Lincolnshire and the adjacent parts, and again in the eastern parts of Kent. Judging from the height of the meteor, its bulk is conjectured to have been not less than half a mile in diameter; and when we consider this bulk, its velocity cannot fail to astonish us, which is supposed to be at the rate of more than 40 miles in a second.

It seems to be the opinion of Dr. Blagden and others, that the general cause of these phenomena is electricity; but notwithstanding the ingenious arguments urged in defence of this hypothesis, we still entertain considerable doubts as to its correctness. The duration of the fire-ball, the unequal consistency of the mass, and several other points in the narration, seem to indicate that its materials were of a less rare and evanescent nature than the electric matter.

The shooting or falling-star is a common phenomenon; but though so frequently observed, the great distance and transient nature of these meteors have hitherto frustrated every attempt to ascertain their cause. The connection of these with an active state of the atmospheric electricity, is however certain from observation; and we have more reason to consider them as electric scintillæ than as solid or fluid matter in the act of combustion. They precede a change of wind.

Concerning the nature and composition of the *ignis fatuus*, or Will-with-a-wisp, there is less dispute; the generality of philosophers being agreed, that it is caused by some volatile vapour of the phosphoric kind, probably the phosphorized hydrogen gas. The light from putrescent substances, particularly putrid fish, and those sparks emitted from the sea, or sea-water when agitated, in the dark, correspond in appearance with this meteor. Sir Isaac Newton defines the ignis fatuus to be "a vapour shining without heat;" and it is usually visible in damp places, about dunghills, burying-grounds, and other situations which are likely to abound with phosphoric matter.

METEORIC STONES. Almost all the larger fire-balls have been observed to disappear with a loud explosion; and it was almost constantly affirmed that heavy stony bodies fell from them. But though several well-authenticated accounts of the fall of such stones had been from time to time published, little credit was given to them by philosophers, till Dr. Chladni published a dissertation on the subject in 1794. Two years after, Mr. King published a still more complete collection of examples, many of them supported by such evidence that it was impossible to reject it. Mr. Howard having procured specimens of the stones which were said to have fallen in different places, compared them together, and subjected them to a chemical analysis. The result was, that all these stony bodies differ completely from every other known stone; that they all resemble each other; and that they are all composed of the same ingredients. They are found entirely different from all known stones, and exactly resemble each other, even in their component parts. They are heated and luminous when they reach the earth: the force of their descent buries them some depth into it; and they have been seen under these circumstances in Italy, Germany, France, England, and India. The meteors either really do, or appear to, move horizontally, and are said to descend ere they explode. The stones are of different sizes, and from a few ounces in weight to several tons; they are generally circular, and invariably covered with a rough black crust, which, according to Howard, is principally composed of oxide of iron. The stones which fell at Laigle, in France, in 1803, yielded by the analysis of Vauquelin and Fourcroy, 54 parts silica, 36 oxide of iron, 19 magnesia, 5 oxide of nickel, 2 sulphur, and 1 lime:—and Mr. Howard found that 150 grains of a meteoric stone which fell in Yorkshire, contained 75 silica, 37 magnesia, 48 oxide of iron, 2 oxide of nickel. The oxidizement of the metallic bodies caused this increase of weight.

Various conjectures have been formed as to the origin of these stones; some, with Laplace, supposing them to be ejected by volcanoes in the moon; and others, with Sir W. Hamilton and Mr. King, that they are concretions formed in the atmosphere.

METEOROLOGY, the doctrine of meteors, or the study of the variable phenomena of the atmosphere. The atmosphere may be considered in respect of the direction of its currents or winds; of the variations in its gravity or pressure; of the changes in its temperature; of the state of the electricity which it exhibits; and lastly, as to the visible phenomena which are supposed to depend on the foregoing. Winds, though proverbially uncertain in some climates, are yet not without a striking degree of regularity and system, if we consider the whole atmosphere: and there is a

part of the world where the wind is so constantly in one quarter, that *windward*, in common speech, stands for eastern, and *leeward* for western. We want only a more extensive set of observations to render exceedingly probable the following hypothesis: That a large portion of the whole atmosphere moves constantly from east to west round the earth, on and near the equator; that this is supplied and impelled by air from the temperate and cold latitudes on each side towards the poles; which again receive, by a superior current, the over flow of the tropical regions, where the air, rarefied by the heat, is constantly rising, and tending to lateral diffusion. Winds appear usually to begin at that point towards which they blow. They must therefore be owing to a rarefaction or displacing of the air in some particular quarter, either by the action of heat, or some other cause.

In 1740, Dr. Franklin was prevented from observing an eclipse of the moon at Philadelphia by a north-east storm, which came on about seven o'clock in the evening. He was surprised to find afterwards that it had not come on at Boston till near 11 o'clock: and he found it to be always an hour later the farther north-east for every 100 miles. "From thence (says he) I formed an idea of the course of the storm, which I will explain by a familiar instance. I suppose a long canal of water stopped by a gate. The water is at rest till the gate is opened; then it begins to move out through the gate; and the water next the gate is first in motion, and moves on towards the gate, and so on successively, till the water at the head of the canal is in motion, which it is last of all. Thus, to produce a north-east storm, I suppose some great refraction of the air in or near the Gulf of Mexico; the air rising thence has its place supplied by the next more northern, cooler, and therefore denser and heavier air; a successive current is formed, to which our coast and inland mountains give a north-eastern direction."

The north-east wind blows most frequently with us during the spring months: and from the observations made by Captain Cook, it appears, that the same wind prevails during the same period in the Northern Pacific. Hence it appears, that at that season the cold air from the north of Europe and America flows into the Atlantic and Pacific.

It is very common to observe one current of air blowing at the surface of the earth, while a current flows in a contrary direction in the higher strata of the atmosphere. Three such winds have been observed blowing in contrary directions all at the same time. It is affirmed, that changes of weather generally begin in the upper strata of the air, the wind which blows there gradually extending itself to the surface of the earth.

With regard to the pressure of the atmosphere, it is every where variable, as appears by the barometer; which indicates to us the weight of a column of air, extending to the top of the atmosphere, and whose base is equal to that of the mercury. At the level of the sea, where the column of air is longest, the mean height of the barometer is thirty inches. The mean height of the barometer is less, the higher any place is situated above the level of the sea, because the column of air which supports the mercury is the shorter.

Between the tropics the variations of the barometer are exceedingly small; and it does not descend above half as much for every 200 feet of elevation as it does beyond the tropics. As the latitude advances toward the poles, the range of the barometer gradually increases, till at last it amounts to two or three inches. This will appear, from the following table:

Table of the Range of the Barometer.

Latitude	Places.	Range of the Barometer	
		Greatest	Annual.
0° 0′	Peru	0.20	—
22 23	Calcutta	0.77	—
33 55	Cape Town	—	0.89
40 55	Naples	1.00	—
51 8	Dover	2.47	1.80
53 23	Liverpool	2.89	1.96
59 56	Petersburg	3.45	2.77

In North America, however, the range of the barometer is a great deal less than in the corresponding European latitudes. In Virginia, for instance, it never exceeds 1.1. The range of the barometer is greater at the level of the sea than on the mountains; and in the same degree of latitude, the extent of the range is in the inverse ratio of the height of the place above the level of the sea.

The density of the atmosphere is greatest at the poles, and least at the equator; as the centrifugal force at the latter, the distance from the centre of the earth, and the heat, contributing to lessen the density of the air, are at their maximum, when at the pole it is exactly the reverse. In every part of the world the mean height of the barometer placed at the level of the sea will be found to be 30 inches, consequently, the weight of the atmosphere is the same in all places; its weight depending on its density and height; where the former is greatest the height must be the least, and where its density is least the height is the greatest. It will therefore appear that the height of the atmosphere must be least at the poles, and greatest at the equator, decreasing gradually in the interval, and thus forming the resemblance of two inclined planes, meeting at the highest part above the equator.

The difference of the mean heat between the pole and the equator, when the sun is in our hemisphere in the summer, does not vary so much as in the winter, as the heat at that period in northern countries equals that of the torrid zone.

The pressure of the superincumbent column in a great measure causes the density of the atmosphere, and therefore decreases in proportion to the height as the pressure of the column constantly decreases, yet the density in the torrid zone does not decrease so rapidly as in the temperate and frigid, as the column is longer, and because there is a larger proportion of air in the upper part of it.

The density at the equator, though less at the surface of the earth, must equal at a cer-

tain height, and still higher exceed the density in the temperate zones, and at the poles; but a current of air constantly ascends at the equator, part at least of which reaches to and remains in the highest parts of the atmosphere; but the fluidity of that body prevents it from accumulating above the equator, and hence it must descend the declined plane before mentioned. The surface of the atmosphere being more inclined in the northern hemisphere during our winter than that of the southern, more of the current must flow on the northern than on the southern, from which cause the quantity of our atmosphere is greater in winter than that of the southern hemisphere; in the summer it is just the contrary.

The heat of any given place in a great measure influences the density of its atmosphere; that density will be most considerable where it is coldest, and its column shortest. Chains of mountains, the summits of which are covered with snow great part of the year, and highlands, must be colder than places less elevated in the same latitude, and the column of air over them much shorter. The current of air above must be impeded and accumulated while on its passage over these places towards the poles.

After the accumulations have existed some time the surrounding atmosphere becomes incapable of balancing the density of the air, when it descends with violence, and occasions cold winds, which raise the barometer; it is to this that we are to attribute the rise of the barometer, almost always attending north-east winds in Europe, which is the effect of accumulations near the pole, or in the north-west parts of Asia.

When in the polar regions large quantities of air are casually compressed; the southern atmosphere must rush in to replace it, which occasions south-west gales, and the fall of the barometer.

The mean heat of our hemisphere varying in successive years, the density of the atmosphere, and necessarily, the quantity of equatorial air passing towards the poles, cannot be otherwise than variable; hence occur the different ranges of the barometer, in successive years; at some particular periods, more considerable accumulations take place in the highest parts of Asia, and the south of Europe, than at others, which may be produced by early falls of snow, or the interruption of the sun's rays by long continued fogs; at such times the atmosphere in the polar regions becomes proportionably lighter, and this causes the prevalence of southerly winds in some winters more than in others.

The heat of the torrid zone never greatly varying, the height and density of the atmosphere undergoes but few changes, thence arises the comparatively small range of the barometer within the tropics, which gradually increases towards the poles, as the difference of the temperature and the density of the atmosphere increases with the latitude. The sinking of the barometer preceding violent tempests, and the oscillations during their continuance, prove that very great rarefactions, or even destruction of air, in some part of the atmosphere produce those phenomena; the fall too that accompanies winds arises from the same cause.

There are considerable variations in the temperature of the air in any particular place, exclusive of the difference of the seasons and climates, which change cannot be produced by heat derived from the sun, as its rays concentrated have no kind of effect on air; those however heat the surface of our globe, which is communicated to the immediate atmosphere: it is thus that the temperature is highest where the place is so situated as to receive with most effect the rays of the sun, and that it varies in each region with the season; it is also the cause why it decreases in proportion to the height of the air above the surface of the earth. The diminution of temperature from the pole to the equator takes place in arithmetical progression; or the annual temperatures of all the latitudes are arithmetical means between the mean annual temperature of the equator and the pole.

The mean temperature of the equator being 84 deg. and that of the pole 31 deg. to find the mean annual temperature for every other latitude, we have only to find 88 arithmetical means between 84 and 31.

It has been found that in every degree of north latitude, January is the coldest month; July the warmest in all above 48 deg. in lower, August. Every latitude where existence can be maintained has a mean of 60 deg. two months of the year at the least, which is requisite for the production of those articles by which man supports life. The temperatures within ten degrees of the poles vary little, and the case is similar within the same distance from the equator; those of different years near the latter differ very little, but the differences increase as the latitudes approach the poles. The temperature of the atmosphere likewise diminishes gradually in proportion to its height above the level of the sea.

Mr. Kirwan shews that the rate of diminution depends upon the precise temperature of the surface of the earth where an experiment is made.

This gradual approach to cold, demonstrates that at a certain height eternal congelation must prevail; that height varies of course according to the latitude of the place, being highest at the equator and gradually descending on approaching the poles, it is also lower in the winter. The cold on the summit of Pinchinca was found by M. Bouguer to extend, every morning previous to the rising of the sun, from seven to nine below the freezing point, from which he conjectured, that the mean height of the term of congelation (or that region where water congeals on some part of every day in the year) between the tropics, is 15,577 feet above the level of the sea; in latitude 28 deg. he supposes it to be 43,440 during summer. Taking the difference between the freezing point and the temperature of the equator, it appears, that it bears the same proportion to the term of congelation at the equator that the difference the mean between temperature of any other degree of latitude, and the freezing point, bears to the term of congelation in that latitude.

Estimating the diminution from this method, we find that heat lessens in an arithmetical progression: and from the same premises it may be concluded, that the warmth of the air at some distance from the earth is not to be attri-

buted to the raising of heated strata of air from the earth's surface, but to the conducting power of the air.

The upper strata of the atmosphere are frequently warmer in winter than the lower, and the preceding rule is applicable to the temperature of the air during the summer months only. According to the Philosophical Transactions for 1777, a thermometer placed on the summit of Arthur's Seat, the 31st of January, the year before, stood six degrees higher than a second at Hawk's Hill, situated 684 feet below it: this superior heat is considered by Mr. Kirwan to be produced by a current of heated air flowing from the equator towards the north pole during our winter.

It has been a generally received opinion, that the southern hemisphere, beyond the 40th degree of latitude, is much colder than the corresponding parts of the northern: this is true only with respect to the summer of the former; but the winter in the same latitude is milder than in the latter.

Inconsiderable seas, in temperate and cold climates, are colder in winter and warmer in summer than the standard ocean, as they are necessarily under the influence of natural operations from the land, and its temperature.

Continents have a colder atmosphere than islands situated in the same degree of latitude; and countries lying to the windward of the superior classes of mountains, or forests, are warmer than those which are to the leeward. Earth always possessing a certain degree of moisture, has a greater capacity to receive and retain heat than sand or stones; the latter therefore are heated and cooled with more rapidity: it is from this circumstance that the intense heats of Africa and Arabia, and the cold of Terra del Fuego, are derived. The temperature of growing vegetables changes very gradually; but there is a considerable evaporation from them: if these exist in great numbers, and congregated, as in forests, their foliage preventing the rays of the sun from reaching the earth, the immediate atmosphere must be greatly affected by the ascent of chilled vapours.

Air is one of those bodies which have received the name of electric; it not only contains that portion of electricity which seems necessary to the constitution of all terrestrial bodies, but it is liable also to be charged negatively or positively when electricity is abstracted or introduced by means of conducting bodies. These different states must occasion a variety of phenomena, and probably contribute considerably to the various combinations and decompositions continually going on in air. Professor Beccaria, of Turin, found the air almost always positively electrical, especially in the day-time and in dry weather. When the dark or wet weather clears up, the electricity is always negative. Low thick fogs, rising into dry air, carry up a great deal of electric matter. In the morning, when the hygrometer indicates dryness equal to that of the preceding day, positive electricity obtains even before sunrise. As the sun gets up, this electricity increases more remarkably if the dryness increases. It diminishes in the evening. The mid-day electricity of days equally dry is proportional to the heat. Winds always lessen the electricity of a clear day, especially if damp. For the most part, when there is a clear sky with little wind, a considerable electricity arises after sunset at dew falling.

Air is not only electrified by friction, like other electric bodies, but the state of its electricity is changed by various chemical operations which often go on in the atmosphere. Evaporation seems in all cases to convey electric matter into the atmosphere. On the other hand, when steam is condensed into water, the air becomes negatively electric. Air, when heated, becomes negatively electric, and positively when cooled, even when it is not permitted to expand or contract: and the expansion and contraction of air also occasion changes in its electric state.

As air is an electric, the matter of electricity, when accumulated in any particular strata, will not immediately make its way to the neighbouring strata, but will induce in them changes similar to what is induced upon plates of glass or similar bodies piled upon each other. Therefore, if a stratum of air is electrified positively, the stratum immediately above it will be negative, the stratum above that positive, and so on. Suppose now, that an imperfect conductor were to come into contact with each of these strata: we know from the principles of electricity, that the equilibrium would be restored, and that this would be attended with a loud noise, and with a flash of light. Clouds are imperfect conductors: if a cloud, therefore, comes into contact with two such strata, a thunder-clap will follow. If a positive stratum is situated near the earth, the intervention of a cloud will, by serving as a stepping-stone, bring the stratum within the striking distance, and a thunderclap will be heard while the electrical fluid is discharging itself into the earth. If the stratum is negative, the contrary effects will take place. It does not appear, however, that thunder is often occasioned by a discharge of electric matter from the earth into the atmosphere. The accidents, most of them at least, which were formerly ascribed to this cause, are now much more satisfactorily accounted for by Lord Stanhope's theory of the returning stroke. The discharge from the clouds directly into the earth is also probably less frequent than from cloud to cloud.

The far greater part of the visible phenomena of the atmosphere are due to the water, which, being raised by evaporation, is transported from place to place in vapour, and which, physically speaking, is a proper component part of the air. When, by any means, a portion of this is deprived of its constituent caloric, it reappears in minute drops, which are at first uniformly diffused, and lessen the transparency of the air in proportion to their abundance.

Another meteorological phenomenon that has recently engaged the attention of the scientific, is the formation of dew. As the reader has been referred to this article for an explanation of this phenomenon, we shall here take a brief view of the subject.

The first facts which could lead to the just explanation of this interesting, and, till very lately, inexplicable natural phenomenon, are due to the late Mr. A. Wilson, professor of astronomy in Glasgow, and his son.

Dr. Wilson had previously, in 1781, described the surface of snow, during a clear and calm night, to be 16° colder than air two feet

above it; and in the above paper he shews, that the deposition of dew and hoar-frost is uniformly accompanied with the production of cold. He was the first among philosophical observers who noticed this conjunction. But the different force with which different surfaces project or radiate heat being then unknown, Dr. Wilson could not trace the phenomena of dew up to their ultimate source. This important contribution to science has been lately made by Dr. Wells, in his very ingenious and masterly essay on dew.

1. *Phenomena of Dew.*

Aristotle justly remarked, that dew appears only on calm and clear nights. Dr. Wells shews that very little is ever deposited in opposite circumstances; and *that little* only when the clouds are very high. It is never seen on nights both cloudy and windy; and if in the course of the night the weather, from being serene, should become dark and stormy, dew which had been deposited will disappear. In calm weather, if the sky be partially covered with clouds, more dew will appear than if it were entirely uncovered.

Dew probably begins in the country to appear upon grass, in places shaded from the sun, during clear and calm weather, soon after the heat of the atmosphere has declined, and continues to be deposited through the whole night, and for a little after sunrise. Its quantity will depend in some measure on the proportion of moisture in the atmosphere, and is consequently greater after rain than after a long tract of dry weather; and in Europe, with southerly and westerly winds, than with those which blow from the north and the east. The direction of the sea determines this relation of the winds to dew. For in Egypt, dew is scarcely ever observed except while the northerly or Etesian winds prevail. Hence also dew is generally more abundant in spring and autumn, than in summer. And it is always very copious on those clear nights which are followed by misty mornings, which shew the air to be loaded with moisture. And a clear morning, following a cloudy night, determines a plentiful deposition of the retained vapour. When warmth of atmosphere is compatible with clearness, as is the case in southern latitudes, though seldom in our country, the dew becomes much more copious, because the air then contains more moisture. Dew continues to form with increased copiousness as the night advances, from the increased refrigeration of the ground.

2. *On the cause of Dew.*

Dew, according to Aristotle, is a species of rain, formed in the lower atmosphere, in consequence of its moisture being condensed by the cold of the night into minute drops. Opinions of this kind, says Dr. Wells, are still entertained by many persons, among whom is the very ingenious Professor Leslie. (*Relat. of Heat and Moisture*, pp. 37, and 132.) A fact, however, first taken notice of by Gersten, who published his treatise on dew in 1773, proves them to be erroneous for he found that bodies a little elevated in the air often become moist with dew, while similar bodies, lying on the ground, remain dry, though necessarily, from their position, *as* liable to be wetted, by whatever falls from the heavens, as the former.

After a long period of drought, when the air was very still and the sky serene, Dr. Wells exposed to the sky, 28 minutes before sunset, previously weighed parcels of wool and swandown, upon a smooth, unpainted, and perfectly dry fir table, 5 feet long, 3 broad, and nearly 3 in height, which had been placed an hour before, in the sunshine, in a large level grass-field. The wool, 12 minutes after sunset, was found to be 14° colder than the air, and to have acquired no weight. The swandown, the quantity of which was much greater than that of the wool, was at the same time 13° colder than the air, and was also without any additional weight. In 20 minutes more, the swandown was $14\frac{1}{2}$° colder than the neighbouring air, and was still without any increase of its weight. At the same time the grass was 15° colder than the air four feet above the ground.

Dr. Wells, by a copious induction of facts, derived from observation and experiment, establishes this proposition, *that bodies become colder than the neighbouring air* BEFORE *they are dewed.* The cold therefore which Dr. Wilson and Mr. Six conjectured to be the effect of dew, now appears to be its cause. But what makes the terrestrial surface colder than the atmosphere? The radiation or projection of heat into free space. Now the researches of Professor Leslie and Count Rumford have demonstrated, that different bodies project heat with very different degrees of force.

In the operation of this principle, therefore, conjoined with the power of a concave mirror of cloud, or any other awning, to reflect or throw down again those calorific emanations which would be dissipated in a clear sky, we shall find a solution of the most mysterious phenomena of dew. Two circumstances must here be considered:—

1. The exposure of the particular surface to be dewed, to the free aspect of the sky.

2. The peculiar radiating power of the surface. 1. Whatever diminishes the view of the sky, as seen from the exposed body, obstructs the depression of its temperature, and occasions the quantity of dew formed upon it to be less than would have occurred, if the exposure to the sky had been complete.

Dr. Wells bent a sheet of pasteboard into the shape of a penthouse, making the angle of flexure 90 degrees, and leaving both ends open. This was placed one evening with its ridge uppermost, upon a grass plat in the direction of the wind, as well as this could be ascertained. He then laid 10 grains of white, and moderately fine wool, not artificially dried, on the middle part of that spot of the grass which was sheltered by the roof, and the same quantity on another part of the grass-plat, fully exposed to the sky. In the morning the sheltered wool was found to have increased in weight only 2 grains, but that which had been exposed to the sky 16 grains. He varied the experiment on the same night, by placing upright on the grass-plat a hollow cylinder of baked clay, 1 foot diameter, and $2\frac{1}{2}$ feet high. On the grass round the outer edge of the cylinder, were laid 10 grains of wool, which in this situation, as there was not the least wind would have received as much rain as a like quantity of wool fully exposed to the sky. But the quantity of moisture acquired by the wool

partially screened by the cylinder from the *aspect* of the sky, was only about 2 grains, while that acquired by the same quantity fully exposed, was 16 grains. Repose of a body seems necessary to its acquiring its utmost coolness, and a full deposite of dew. Gravel walks and pavements project heat, and acquire dew, less readily than a grassy surface. Hence wool placed on the former has its temperature less depressed than on the latter, and therefore is less bedewed. Nor does the wool here attract moisture by capillary action on the grass, for the same effect happens if it be placed in a saucer. Nor is it by hydrometric attraction; for in a cloudy night, wool placed on an elevated board acquired scarcely any increase of weight.

If wool be insulated a few feet from the ground on a bad conductor of heat, as a board, it will become still colder than when in contact with the earth, and acquire fully more dew than on the grass. Glass projects heat rapidly, and is as rapidly coated with dew. But bright metals attract dew much less powerfully than other bodies. If we coat a piece of glass, partially, with bright tin-foil, or silver leaf, the uncovered portion of the glass quickly becomes cold by radiation, on exposure to a clear nocturnal sky, and acquires moisture; which, beginning on those parts most remote from the metal, gradually approaches it. Gold, silver, copper, and tin, bad radiators of heat, and excellent conductors, acquire dew with greater difficulty than platina, which is a more imperfect conductor; or than lead, zinc, and steel, which are better radiators. Hence dew which has formed upon a metal will often disappear, while other substances in the neighbourhood remain wet; and a metal, purposely moistened, will become dry, while neighbouring bodies are acquiring moisture. This repulsion of dew is communicated by metals to bodies in contact with, or near them. Wool laid on metal acquires less dew than wool laid on the contiguous grass.

When, during a clear and still night, different thermometers, placed in different situations, were examined at the same time, those which were situated where most dew was formed, were always found to be the lowest. On dewy nights the temperature of the earth, half an inch or an inch beneath the surface, is always found much warmer than the grass upon it, or the air above it. The differences on five such nights, were from 12 to 16 degrees.

In making experiments with thermometers, it is necessary to coat their bulbs with silver or gold leaf, otherwise the glassy surface indicates a lower temperature than that of the air, or the metallic plate it touches. Insulated bodies, or prominent points, are sooner covered with hoar-frost and dew than others; because the equilibrium of their temperature is more difficult to be restored. As aerial stillness is necessary to the cooling effect of radiation, we can understand why the hurtful effects of cold, heavy fogs, and dews, occur chiefly in hollow and confined places, and less frequently on hills. In like manner, the leaves of trees often remain dry throughout the night, while the blades of grass are covered with dew.

No direct experiments can be made to ascertain the manner in which clouds prevent or lessen the appearance of a cold at night, upon the surface of the earth, greater than that of the atmosphere. But it may be concluded from the preceding observations, that they produce this effect almost entirely by radiating heat to the earth, in return for that which they intercept in its progress from the earth towards the heavens. The heat extricated by the condensation of transparent vapour into cloud must soon be dissipated; whereas, the effect of greatly lessening, or preventing altogether, the appearance of a greater cold on the earth than that of the air, will be produced by a cloudy sky during the whole of a long night.

We can thus explain, in a more satisfactory manner than has usually been done, the sudden warmth that is felt in winter, when a fleece of clouds supervenes in clear frosty weather. Chemists ascribed this sudden and powerful change to the disengagement of the latent heat of the condensed vapours; but Dr. Wells's thermometric observations on the sudden alternations of temperature by cloud and clearness, render that opinion untenable. We find the atmosphere itself, indeed, at moderate elevations, of pretty uniform temperature, while bodies at the surface of the ground suffer great variations in *their* temperature. This single fact is fatal to the hypothesis derived from the doctrines of latent heat.—"I had often," says Dr. Wells, "smiled, in the pride of half knowledge, at the means frequently employed by gardeners to protect tender plants from cold, as it appeared to me impossible that a thin mat, or any such flimsy substance, could prevent them from attaining the temperature of the atmosphere, by which alone I thought them liable to be injured. But when I had learned, that bodies on the surface of the earth become, during a still and serene night, colder than the atmosphere, by radiating their heat to the heavens, I perceived immediately a just reason for the practice which I had before deemed useless. Being desirous, however, of acquiring some precise information on this subject, I fixed, perpendicularly, in the earth of a grass-plat, four small sticks, and over their upper extremities, which were six inches above the grass, and formed the corners of a square whose sides were two feet long, I drew tightly a very thin cambric handkerchief. In this disposition of things, therefore, nothing existed to prevent the free passage of air from the exposed grass to that which was sheltered, except the four small sticks, and there was no substance to radiate downwards to the latter grass, except the cambric handkerchief."

The sheltered grass, however, was found nearly of the same temperature as the air, while the unsheltered was 5° or more colder. One night the fully exposed grass was 11° colder than the air; but the sheltered grass was only 3° colder. Hence we see the power of a very slight awning, to avert or lessen the injurious coldness of the ground. To have the full advantage of such protection from the chill aspect of the sky, the covering should not touch the subjacent bodies. Garden walls act partly on the same principle. Snow screens plants from this chilling radiation.

From this rapid emission of heat from the surface of the ground, we can now explain the formation of ice during the night in Bengal,

while the temperature of the air is above 32°. The nights most favourable for this effect, are those which are the calmest and most serene, and on which the air is so dry as to deposit little dew after midnight. Clouds and frequent changes of wind are certain preventives of congelation. Three hundred persons are employed in this operation at one place. The enclosures formed on the ground are four or five feet wide, and have walls only four inches high. In these enclosures, previously bedded with *dry* straw, broad, shallow, unglazed earthen pans are set, containing *unboiled pump-water.* Wind, which so greatly promotes evaporation, prevents the freezing altogether, and dew forms in a greater or less degree during the whole of the nights most productive of ice. If evaporation were concerned in the congelation, wetting the straw would promote it. Moist straw both conducts heat and raises vapour from the ground, so as to obstruct the congelation.

To dew succeed various definite aggregates under the name of cloud. Out of the latter are formed rain, snow, and hail, by which the product of evaporation is finally restored to the earth. The excess for any given time, of the falling water over that which is evaporated, passes off by the springs and rivers to that grand reservoir which forms the far greater part of the surface of the globe. Tracts of forest, especially if mountainous, invite the rain, and protect the springs; while the accumulated heat on cultivated plains often causes the clouds to pass over them, or to be dissipated.

The quantity of rain taken at an annual mean, is the greatest at the equator, and it decreases gradually to the poles; but there are fewer days of rain there, the number of which increase in proportion to the distance from it. From north latitude 12 deg. to 43 deg. the mean number of rainy days is 78; from 43 deg. to 46 deg. the mean number is 103; from 46 deg. to 50 deg. 134: and from 51 deg. to 60 deg. 161. Winter often produces a greater number of rainy days than summer, though the quantity of rain is more considerable in the latter than in the former season. Mountainous districts are subject to great falls of rains, among the Andes particularly, it rains almost incessantly; while the flat country of Egypt is consumed by endless drought. The rain-guage affords reason to suppose, that a greater quantity of rain falls in the lower strata of the atmosphere than in those above, which may be accounted for by the drops attracting vapour in their near approach to the earth. Mr. Copland, of Dumfries, has however discovered the rain collected in the lower guage was greatest when it continued falling for some time, and that the greatest quantity was collected in the higher during short rains, or at the conclusion of lengthened ones.

As rain is known to fall at all hours of the day and night, and at every season of the year, it is apparent that it is caused by operations which prevail eternally, and without defined interruption. The mean annual quantity of rain for the whole globe has been calculated to be about 34 inches. The superficies of the globe consists of 170,981,012 square miles, or 686,401,498,171,475,200 square inches; the quantity of rain, therefore, falling annually, will amount to 23,337,650,812,030,156,800 cubic inches, or somewhat more than 91,751 cubic miles of water. There are 52,745.253 square miles of dry land on the globe; consequently the annual amount of the quantity of rain descending upon it will be 30,960 cubic miles. The sea is supposed to receive 13,140 cubic miles of water, which flow into it annually; therefore it must supply an equal quantity by evaporation. Mr. Dalton estimates the quantity of rain falling in England at 31 inches.

Snow is formed by a process of regular crystallization among the minute frozen particles of water floating in the air. Previous to and during the fall of snow in quantity, the temperature continues about 32 deg. It should seem that the evolution of the constituent caloric of the water produces the same effect when ice is formed in the atmosphere, as when it is formed in water. The structure of a crystal of snow demonstrates that a drop of rain is also formed by the union of a great number of smaller drops. When these come together in the act of freezing, and suddenly, they form a nucleus of white spongy ice, which, by its extreme coldness, become incrusted with clear ice from the water it collects in its descent, constitutes hail as we usually see it. Sometimes, however, the nucleus falls unincrusted, which is a prognostic of sharp frosts. Hail has been likewise observed perfectly transparent, and having the form of an oblate spheroid, showing that it consisted of drops which had been frozen entire in falling with a rotatory motion.

The forms assumed by the suspended water in the interval between the first precipation and the descent of rain, afford a copious field of observation. These are not, as might be hastily supposed, the sport of winds, changing with every movement of the containing medium. Indeed the atmosphere, at the height where the clouds usually appear, is undisturbed by the various obstacles which throw it into contending streams and eddies near the surface of the earth, and flows in a more direct and even current. Accordingly, the particles of water which it contains are allowed to assume a certain arrangement; and constitute a form, which is often equally well defined at a distance with that of solids, although, were we to penetrate it, we should perceive only the grey mist.

As this most interesting part of the subject has been already treated of under the article *cloud,* we shall not here repeat it, but refer the reader to that article, in which he will find a description of the various modifications of suspended vapour exhibited in plate XXXIII.

Among the more modern works on the subject of meteorology, the best that has come under our notice is that of Mr. Daniell, who sums up the leading facts of the science in the following propositions.

1. The mean height of the barometer at the level of the sea is the same in every part of the globe.

2. The barometer constantly descends in a geometrical progression, for equal ascents in the atmosphere subject to a correction for the decreasing temperature of the elevation.

3. The mean temperature of the earth's surface increases gradually from the poles to the equator.

4. The mean temperature of the atmosphere decreases from below upwards in a regular gradation.

The fact is sufficiently established by numerous observations. Mr. Dalton was the first to demonstrate the natural equilibrium of heat in an atmosphere, is when an atom of air, in the same perpendicular column, is possessed of the same quantity of heat, and consequently that an equilibrium results when the temperature gradually diminishes in ascending. This the natural consequence of the increased capacity for heat derived from rarefaction.

5. The barometer at the level of the sea but very slightly affected by the annual or diurnal fluctuations of temperature.

6. The barometer in the higher regions of the atmosphere is greatly affected by the annual and diurnal fluctuations of temperature.

This observation is easily confirmed in various ways, but it is sufficient to refer for its correctness to those valuable registers which are simultaneously kept at Geneva and the summit of Mount St. Bernard.

7. The heating and cooling of the atmosphere by the changes of day and night, take place equally throughout its mass. This is fully established by the same series of observations.

8. The average quantity of vapour in the atmosphere decreases from below upwards, and from the equator to the poles. This consequence is obviously derivable from the preceding laws of temperature, and is moreover amply confirmed by experiment.

9. The condensation of elastic vapour into cloud raises the temperature of the air.

In confirmation of this theoretical and practical conclusion, the observation of M. De Luc may be adduced.

10. Another remarkable phenomenon is, that there exists a general tendency in the wind to blow from north to east, and south-east towards the equator in latitudes below 30°.

11. While the trade wind blows upon the surface of the earth, a current flows in the contrary direction at a great elevation in the atmosphere

This necessary consequence of the theory of the trade-winds, rested for a long time upon theoretical conclusions only; the eruption, however, of the volcano in the Island of St. Vincent, in the year 1812, placed the fact beyond dispute. The Island of Barbadoes is situated considerably to the east of St. Vincent, and between the two the trade wind continually blows, and with such force that it is with considerable difficulty, and only by making a very long circuit that a ship can sail from the latter to the former; notwithstanding this, during the eruption at St. Vincent, dense clouds were formed at a great height in the atmosphere above Barbadoes, and a vast profusion of ashes fell upon the Island. This apparent transportation of matter against the wind caused the utmost astonishment amongst the inhabitants, and the certainty of the fact cannot but be considered as of the utmost interest to the science of meteorology.

12 The mean height of the barometer is not effected by the trade winds.

This is a proof that the quantity of air which passes below from the poles to the equator, must be exactly balanced by an equal quantity flowing above in the opposite direction.

13. Between the latitudes 30° and 40°, both in the northern and southern hemispheres, westerly winds prevail.

14. The western coasts of the extratropical continents have a much higher mean temperature than the eastern coasts.

This difference is extremely striking between the western coast of North America, and the opposite eastern coast of Asia. It is explained by the heat evolved in the condensation of vapour swept from the surface of the

that it arrives upon the eastern coasts is extremely dry; as it moves onwards it bears before it the humid atmosphere of the intermediate seas, and arrives upon the opposite shores in a state of saturation. Great part of the vapour is there at once precipitated, and the temperature of the climate raised by the evolution of its latent heat.

15. A wind generally sets from the sea to the land during the day, and from the land to the sea during the night, especially in hot climates.

The land and sea breezes are amongst the most constant of the phenomena of the inconstant subject with which we are occupied; the land becomes much more heated by the action of the sun's rays than the adjacent water; and the incumbent atmosphere is proportionably rarefied: during the day therefore the dense air of the ocean rushes to displace that of the land; at night, on the contrary, the deep water cools much more slowly than the land, and the reverse action takes place as these changes proceed gradually. The height of the barometer is not affected by them.

16. The trade winds in the neighbourhood of the western coasts of the large continents in their course have their direction changed.

This is an effect of the same nature as that of the land and sea breezes. Those parts of Africa and America, which lie between the tropics, become intensely heated by the action of a vertical sun: the columns of the atmosphere which rest upon them must therefore be highly rarefied, and the more temperate air of the surrounding seas will press upon them. This influence is so decided as to overcome the tendency of the east wind; and on the western coasts of both continents a wind from the west prevails. This is again an instance of a complete perpendicular change from a permanent cause, and the total pressure is unaffected.

Of the same nature are the monsoons of the Indian Ocean and other periodical winds: they are occasioned by a particular distribution of land and water, acted upon by the periodical changes of the sun's declination. While the sun is vertical to the places where they occur, the land becomes heated, and the air expanded, and the wind flows towards the coasts as the sun retires towards the opposite point of its course; the land cools faster than the surrounding seas, and the course of the wind is westward, the simplest way of regarding the sun's motion in declination, as affecting the temperature of the various latitudes, is to suppose a motion of the whole system; by which the line of greatest heat, and the two points of greatest cold, maintaining their relative distances, vibrate on either side of the earth's equa-

tor and poles. None of these changes affect the barometer.

17. Rain seldom occurs in the constant trade winds, but abundantly and constantly in the adjoining latitudes.

Between the tropics the elasticity of the aqueous vapour reaches its maximum amount, and within these limits only, rises to any extent into the upper current of the atmosphere. Its own force, which is laterally exerted, is assisted by the equatorial wind, and it flows to the north and south as fast as it rises within the zone, no accumulation can therefore be formed, and the temperature being remarkably steady, seldom varying more than two or three degrees, precipitation can but seldom occur.

The continental parts, however, of the same regions being liable to greater vicissitudes of heat, are subject to rainy seasons, which are periodical, like the monsoons of the same climates, and are governed as they are by the progress of the sun in declination. The condensation, while it lasts, is in proportion to the density of the vapours, and is violent beyond any thing that is known in temperate climates. The alternate seasons of fine weather are distinguished by cloudless skies and perfect serenity. The extra tropical latitudes, on the contrary, beyond the bounds of the trade winds, are at all times exposed to great precipitations; the vapour in its course is subjected to a rapidly decreasing temperature, and the condensation is fed by a constant supply. We are thus led to the consideration of a temperate zone and a variable climate.

18. Between the tropics the fluctuations of the barometer do not much exceed ¼ of an inch, while beyond this space they reach to three inches.

19. In the temperate climates the rains and the winds are variable.

20. As we advance towards the polar regions we find the irregularities of the wind increased, and storms and calms repeatedly alternate, without warning or progression.

The extremes of heat and cold will sometimes prevail within a very limited compass; and forcible winds will blow in one place, when at the distance of a few leagues gentle breezes prevail. Ships within the circle of the horizon may be seen enduring every variety of wind and weather at the same moment; some under close reefed top-sails labouring under the force of a storm; some becalmed, and tossing about by the violence of the waves, and others plying under gentle breezes, from quarters as diverse as the cardinal points. The fluctuations of the barometer are also great and sudden, proving that theory would have induced us to conclude that the irregularities of these regions extend to the higher strata of the atmosphere.

21. In the extra tropical climates a fall in the barometer almost always precedes a fall of rain, and indicates an acceleration or change of the aerial currents.

22. Barometers situated at great distances from each other often rise and fall together with great regularity.

23. More than two currents may often be traced in the atmosphere at one time by the motions of the clouds, &c.

24. The force of the winds does not always decrease as the elevation increases, but, on the contrary, is often found to augment rapidly.

25. The variations of the barometer are less in high situations than in those at the level of the sea.

26. In Great Britain, upon an average of ten years, westerly winds exceed the easterly in the proportion of 225 to 140.

Of those from the east the northerly exceed the southerly in the proportion of about 74 to 54; leaving but a very small proportion indeed which blow from the most irregular point, *viz.* the south east.

27. Upon the same average the northerly winds are to the southerly, 192 to 173.

28. Northerly winds almost invariably raise the barometer, while southerly as constantly depress it.

29. The most permanent rains of this climate come from the southerly regions.

30. The mean height of the barometer varies but little with the changes of the seasons.

31. The elasticity of the aqueous vapour does not decrease gradually as we ascend in the atmosphere, in proportion to the gradual decrease of the temperature and density of air: but the dew point remains stationary to great heights, and then suddenly falls to a large amount.

32. The tension of vapour given of in the process of evaporation is determined, not by the temperature of the evaporating surface, but by the elasticity of the aqueous atmosphere already existing.

33. The apparent permanency and stationary aspect of a cloud is often an optical deception arising from the solution of moisture on one side of a given point, as it is precipitated on the other.

34. The quantity of vapour in the atmosphere, in the different seasons of the year (measured on the surface of the earth, and near the level of the sea,) follows the progress of the mean temperature.

35. The pressure of the aqueous atmosphere, separated from that of the aerial, generally exhibits directly opposite changes to the latter.

36. Great falls of the barometer are generally accompanied by a temperature above the mean for the season, and great rises by one below the same. That the different phases of the moon have some connexion with changes in the atmosphere, is an opinion so universal and popular as to be on that account alone entitled to attention. No observation is more general, and on no occasion perhaps is the almanac so frequently consulted as in forming conjectures upon the state of the weather. The common remark, however, goes no further than that changes from wet to dry, and from dry to wet, generally happen at the changes of the moon. When to this result of universal experience we add the philosophical reasons for the existence of tides in the aerial ocean, we cannot doubt that such a connexion exists. The subject however, is involved in much obscurity.

This article having already become too protracted we cannot enter on any description of the instruments used in the science of meteorology; we shall therefore simply mention the most essential of these, some of which will be found described in other parts of this work

The changes to which the atmosphere is most subject are its *temperature*, *weight*, *moisture*, and *electricity*; and the instruments by which these are respectively measured are the ***thermometer***, ***barometer***, ***hygrometer***, and ***electrometer***. The result of these changes is in some cases *wind*, and in others rain or snow, which have also been subjected to measurement; the intensity of the former by ***anemometer***, and the quantity of the latter by the *pluviometer*, or *rain-guage*. It may be proper to observe that these instruments should be of the very best construction, otherwise the results of observations made with them cannot be depended on.

METHOD, in logic, &c. the arrangement of our ideas in such a regular order, that their mutual connection and dependence may be readily comprehended.

METHODISTS. The term Methodist was first given to Themison, the founder of a sect of physicians at Rome, which flourished about three hundred years, and had some of the greatest physicians of the age among its members.

In the seventeenth century there sprung up a new species of polemic doctors, who were denominated Methodists, and distinguished themselves by their zeal and dexterity in defending the church of Rome against the attacks of the Protestants. This sect is now no more; and the appellation is made to designate the followers of the late Messrs. John and Charles Wesley, and the societies founded by the Rev. George Whitefield. They are divided into Whitefieldian and Wesleyan Methodists. The members of the former division embrace the doctrines of Calvin; the latter, as far as relates to free-will, are Arminians.

METONYMY, in rhetoric, is a trope in which one name is put for another, on account of the near relation there is between them. By this trope any of the most significant circumstances of a thing are put for the thing itself. See RHETORIC.

METOPE. See ARCHITECTURE.

METRE, in poetry. See HEXAMETER, PENTAMETER, &c.

MEZEREON. See DAPHNE.

MEZZOTINTO. See ENGRAVING.

MIASMA, among physicians, denotes the contagious effluvia of pestilential diseases, whereby they are communicated to people at a distance

MICA. This stone forms an essential part of many mountains, and has been long known under the names of glacies Mariæ, and Muscovy glass. It consists of a great number of thin laminæ adhering to each other, sometimes of a very large size. Specimens have been found in Siberia nearly 2½ yards square.

Its texture is foliated. Its fragments flat. The lamellæ flexible, and somewhat elastic. Very tough. Often absorbs water. Specific gravity from 2.6546 to 2.9342. Feels smooth, but not greasy. Powder feels greasy. Colour, when purest, silver white or grey; but it occurs also yellow, greenish, reddish-brown, and black. Mica is fusible by the blowpipe into a white, grey, green, or black enamel; and this last is attracted by the magnet.

Mica has long been employed as a substitute for glass. A great quantity of it is said to be used in the Russian marine for panes to the cabin-windows of ships. It is also used in our navy for lantherns, for the use of the powder-rooms,

MICROMETER. An astronomical machine, which, by means of a screw serves to measure extremely small distances in the heavens, &c. and that to a great degree of accuracy.

The micrometer consists of a graduated circle, plate XXVI, fig 7, of a screw *q o*, and its index *q r*. The threads of the screw are such, that 50 make the length of one inch exactly. When it is to be used, the point *o* is set to the side of the part to be measured, and then the index is turned about with the finger, till the eye perceives the point has just passed over the diameter of that part; then the number of turns, and parts of a turn, shewn by the graduated circle, will give the dimensions in parts of an inch, as we shall show by the following example: Suppose it is required to measure the diameter of a human hair, and I observe the index is turned just once round while the point *o* passes over it; then it is plain the diameter of the hair in the image is $\frac{1}{50}$th of an inch. Now if the microscope, I D E F, *d e f*, magnifies 6 times, or makes the image 6 times larger in diameter than the object, then is the diameter of the hair itself but $\frac{1}{6}$th of $\frac{4}{50}$, that is, but $\frac{1}{300}$th, part of an inch.

Also it is to be observed, that as there are ten large divisions, and twenty small ones, on the micrometer plate, so each of those small divisions is the $\frac{1}{20}$th of $\frac{1}{50}$th, or the $\frac{1}{1000}$th part of an inch. Therefore, if, in measuring any part of an object, you observe how many of these smaller divisions are passed over by the index, you will have so many thousandth parts of an inch for the measure required.

There have been micrometers contrived by various persons. We shall describe one invented by Mr. Cavallo, which consists of a small semitransparent scale or slip of mother-of-pearl, about the 20th part of an inch broad, and of the thickness of common writing paper. It is divided into a number of equal parts by means of parallel lines. The micrometer is situated within the tube, at the focus of the eye-lens of the telescope, where the image of the object is formed, and with its divided edge passing through the centre of the field of view. It is to be fixed upon the diaphragm, which generally stands within the tube at the focal distance of the eye-lens.

By looking through the telescope, the image of the object and the micrometer will appear to coincide; hence the observer may easily see how many divisions of the latter measure the length or breadth of the former; and knowing the value of the divisions of the micrometer, he may easily determine the angle which is subtended by the object.

MICROSCOPE. See OPTICS.

MIDWIFERY, in the restricted sense of the word, is the art of assisting women in childbirth. It is generally, however made to comprehend the management of women, both

previous to, and some time after, delivery; as well as the treatment of the infant in its early state

The nature of this subject is such that no abridgment of it could convey an adequate idea of it, particularly without plates; and as we do not expect that the *experienced accoucheur* will open our little volume for the purpose of obtaining information, we should deem it worse then a waste of time to gratify the idle curiosity of such as have no real use for information on a subject of such extreme delicacy.

MIGRATION, *of birds.* It has been generally believed, that many different kinds of birds annually pass from one country to another, and spend the summer or the winter where it is most agreeable to them: and that even the birds of our own island will seek the most distant southern regions of Africa, when directed by a peculiar instinct to leave their own country. It has long been an opinion pretty generally received, that swallows reside during the winter season in the warm southern regions; and Mr. Adamson particularly relates his having seen them at Senegal, when they were obliged to leave this country. But besides the swallow, Mr. Pennant enumerates many other birds which migrate from Britain at different times of the year, and are then to be found in other countries; after which they again leave these countries, and return to Britain.

These are the hooded crow, the cuckoo, the wryneck, the hoopoe, grouse, ring-doves, turtle-doves, the stare, thrushes, chatterers, grosbeaks, buntings, finches, larks, fly-catchers, wagtails, warblers, nightingales, black-caps, willow-wrens, white-ears, white-throats, goatsuckers, several kinds of water-fowl, such as herons, curlews, snipes, sandpipers, plovers, oyster-catchers, rails, phalaropes, grebes, avosets, auks, divers, tem, petrels, mergansers, several species of ducks, and corvorants.

MILE, a measure of length or distance, containing eight furlongs.

The English, statute-mile is four-score chains, or 1760 yards; that is 5280 feet. See CHAIN, YARD, and FOOT.

The following is a list of the itinerary measures of some of the principal European nations in English yards.

	English Yards.
Arabian Mile	2148
Bohemian Mile	10137
Chinese Lis	629
Danish Mile	8244
Dutch Mile	6395
English Mile	1760
Flemish Mile	6869
German Miles, long	10126
German Miles, short	6859
Hamburg Mile	8244
Irish Mile	3038
Italian Mile	2025
Oldenburgh Mile	10820
Portuguese Legoas	6760
Prussian Miles	8468
Russian Versts	1167
Scotch Miles	1984
Spanish Leguas, common	7416
Spanish Leguas, legal	4635
Turkey Berries	1826
Westphalian Miles	12151

MILIARY FEVER, a malignant fever, so called from the eruption of certain pustules resembling millet-seeds. See MEDICINE.

MILIUM, MILLET, a genus of the digynia order, in the triandria class of plants; and in the natural method ranking under the 4th order, gramina. The calyx is bivalved and uniflorous; the corolla is very short: the stigmata pencil-like. There are 12 species, of which the most remarkable is the effusum, or common millet.

MILK, is a fluid secreted by the female of all those animals denominated mammalia, and intended evidently for the nourishment of her offspring.

The milk of every animal has certain peculiarities which distinguish it from every other milk. But the animal whose milk is most made use of by men as an article of food, and with which, consequently, we are best acquainted, is the cow. Chemists, therefore, have made choice of cows' milk for their experiments.

Milk is an opaque fluid, of a white colour, a slight peculiar smell, and a pleasant sweetish taste. When newly drawn from the cow, it has a taste very different form that which it acquires after it has been kept for some hours.

When milk is allowed to remain at rest, it separates into a thick white fluid, called cream, which collects on the surface, and the fluid beneath which is more watery. The quantity of cream obtained from milk, and the time it requires to separate, vary according to the nature of the milk, and the temperature of the atmosphere. When the milk is allowed to stand after the spontaneous separation of the cream, it first becomes acescent, and then coagulates. When the coagulum is pressed gently, a serous fluid is forced out, and the remainder is the caseous part or pure cheese. Butter and cheese are obtained artificially: the former by the operation of churning, and the milk which remains after the butter has been separated, or, as it is called the butter-milk, has all the properties of milk from which the cream has been separated. Cheese is obtained by the addition of rennet to the milk, which is prepared by digesting the inner coat of the stomach of young sucking animals, especially that of the calf. The quality of cheese depends upon the quantity of cream remaining in the milk. The best cheese is obtained by coagulating the milk at the temperature of 100°, and expressing the whey slowly and gradually, without breaking down the curd. Whey expressed from coagulated milk, if boiled, and the whole curd precipitated becomes transparant and colourless. By slow evaporation it deposits crystal of sugar, with some muriate of pot-ash, muriate of soda, and phosphate of lime. The liquid which remains after the separation of the salts, is converted by cooling, into a gelatinous substance If whey be kept it becomes sour by the formation of the lactic acid, and it is to this that the spontaneous coagulation of milk is owing. Milk may, after it is sour, be fermented, and it will yield a vinous intoxicating liquor. Milk is likewise susceptible of the acetous fermentation. The constituent parts which enter into the composition of milk, are water, oil, curd, gelatine, sugar of milk, muriate of soda, muriate of potash, phosphate of lime, and sulphur

The milk of different animals is composed of nearly the same substances; but the proportions vary so much, as to give them very different properties. Every kind of milk produces cream. In that of the cow it is copious, thick, and yellow. In woman's milk the quantity is small, and it is white and more liquid. Goat's milk produces abundance, and it is thicker and whiter than that from the cow. Ewe's milk produces as much as that of the cow, and of nearly the same colour. The cream from asses' milk resembles women's. In mare's milk it is very fluid, and similar in colour and consistence to good cow's milk before the cream appears on the surface. Butter obtained from the milk of the cow differs in colour; but has always much consistency. That from women's milk is small in quantity, insipid, and of a paleyellow. The butter of asses' milk is white, and soft, and disposed to be rancid. That from goat's milk is abundant, white, and soft. That from ewe's milk is yellow and soft: that from mare's milk has little consistence, and is readily decomposed. The caseous part of milk varies in different animals. That from the milk of the cow is bulky, and retains much serum. That from women's milk is small in quantity, has an unctuous feel, and but a small portion of whey. The curd of asses' milk is similar to that of women's, but not unctuous. Curd from the milk of the goat is abundant, of a firmer consistence than that of the cow, and retains less whey. Curd from ewe's milk is fat and viscid: that from mare's milk is very similar to what is obtained from women's milk. The serum, or whey, constitutes a great proportion of the milk. That from the milk of the cow has a greenish cast, and a sweet taste; it contains sugar of milk and neutral salts. The whey from woman's milk has little colour; but contains much saccharine matter. The whey of asses' milk is colourless, and contains less salts and more sugar than that of the cow. Whey of the goat is yellowish, and contains very little sugar and saline matter. The latter is muriate of lime. The whey of ewes' milk is always colourless, and contains the smallest quantity of sugar, and but a small portion of muriate and phosphate of lime. That of mare's milk has little colour, and contains a large proportion of saccharine matter, and of saline substances.

MILKY-WAY, in astronomy, a broad track or path, encompassing the whole heavens, distinguishable by its white appearance, whence it obtains its name.

MILL, a machine or engine for grinding corn, &c. of which there are several kinds, according to the various methods of applying the moving power; as water-mills, wind-mills, mills worked by horses, &c. In water-mills, the momentum of the water is the moving power; and the attrition of the two stones in grinding is the force to be overcome. Of these there are two kinds, viz. those where the force of the water is applied above the wheel, and those where it is applied below the wheel; the former being called overshot, and the latter undershot mills: and to these we may add a breast-mill, where the water strikes against the middle of the wheel. Corn is ground by two mill-stones, placed one above the other, without touching. The lower, or nether mill-stone, is immoveable; but the upper one turns upon a spindle. The opposite surfaces of the two stones, which act to grind the corn, are not plane or flat; but the upper one is hollow, and the under one swells upwards, each of them being of a conic figure, whose axis is very short in proportion to the diameter of its base: for the upper one, being six feet in diameter, is hollowed but about one inch at its centre; and the lower one rises but about three-fourths of an inch. These two mill-stones come nearer and nearer towards their circumference, whereby the corn that falls from the hopper has room to insinuate between them as far as two-thirds of the radius, which is the place where it begins to be ground, and where it makes the greatest resistance that it is capable of; the space between the stones being in that place but about two-thirds or three-fourths of the thickness of a grain of corn. But as the millers have the means of raising or sinking the upper stone a little, they can proportion its distance from the lower one, according as they would have the flour finer or coarser. The circular motion of the upper mill-stone brings the corn out of the hopper by jerks, and causes it to recede from the centre towards the circumference; where being quite reduced to flour, it is thrown out of the mill, by the centrifugal force of the stone, through a hole provided on purpose. Mr. Smeaton has considered the best methods of constructing all these mills from machines and models made on purpose; but, conscious of the inferiority of models to actual practice, did not venture to give his opinion without having seen them actually tried, and the truth of his doctrines established by practice. Having described the machines and models used for making his experiments, he observes, that, with regard to power, it is most properly measured by the raising of a weight; or, in other words, if the weight raised is multiplied by the height to which it can be raised in a given time, the product is the measure of the power raising it; and, of consequence, all those powers are equal whose products made by such multiplication are equal: for if a power can raise twice the weight to the same height, or the same weight to twice the height, in the same time that another can, the former power will be double the latter; but if a power can only raise half the weight to double the height, or double the weight to half the height, in the same time that another can, the two powers are equal. This, however, must be understood only of a slow and equable motion, without acceleration or retardation.

To compute the effects of water-wheels correctly, it is necessary to know, in the first place, what is the real velocity of the water which impinges on the wheel; 2. The quantity of water expended in a given time; and, 3. How much of the power is lost by the friction of the machinery.

Mr. Smeaton determined, from a variety of experiments, that the mean power of a volume of water 15 inches in height, gave 8.96 feet of velocity in each minute to a wheel on which it impinged. The computation of the power to produce such an effect, allowing the head of water to be 105.8 inches, gave 264.7 pounds of water descending in one minute through the space of 15 inches: therefore 264.7, multiplied by 15, was equal to 3.970. But as that power

is found equal to raising no more than 9.375 pounds to the height of 135 inches, it was manifest that a major part of the power was lost; for the multiplication of these two sums amounted to no more than 1,266; of course the friction was equal to $\frac{3}{4}$ths of the power.

Mr. Smeaton considers the above to be the maximum single effect of water upon an undershot wheel, where the fall is 15 inches. The remainder of power, it is plain, must be equal to that of the velocity of the wheel itself, multiplied into the weight of the water, which in this case brings the true proportion between the power and the effect to be as 3,849 to 1,266; or as 11 to 4.

Where a wheel revolved 86 times in a minute, the velocity of the water must have been equal to 86 circumferences of the wheel; which, according to the dimensions of the apparatus used by Mr. Smeaton, was as 86 to 30, or as 20 to 7. The greatest load with which the wheel would move was 9*lb.* 6*oz.*; by 12 *lb.* it was entirely stopt. From this we are to conclude, as Mr. Smeaton did, that the impulse of the water is more than double what our theory states it to be. This he accounts for by the wheel being placed in a narrow slit; so that the water could not escape but by passing with the wheel's motion; thus giving a multiplied force. Further, when a float-board comes in contact with the water, it receives a certain check, which causes the back, or upper part of the float-board to become loaded with a kind of wane, which accumulates in consequence of the momentary impediment, and consequently adds to the impetus. This added force must ever be in proportion to the depth to which the float-board sinks into the stream; not exceeding its whole depth beyond the rim, or body, of the wheel to which it is attached.

The following conclusions result from the velocities of wheels, as acted upon by different heights of water. 1. The head, or altitude, being the same, the effect will be proportioned to the quantity of water expended; or, in other words, according to the weight and velocity of the impending fluid. 2. The expence or quantity of water being the same, the effect will be nearly in proportion to the height of the head. 3. The quantity of water expended being the same, the effect is nearly as the square of the velocity. 4. The aperture whence the fluid issues being the same, the effect will be nearly as the cube of the velocity. 5. The virtual head, or that from which we calculate the power, bears no proportion to the head-water; but when the aperture is larger, or the velocity of the water less, they approach nearer to a coincidence: consequently in the large openings of mills and sluices, where great quantities of water are discharged from moderate areas, the head of water, and the virtual head (determined from the velocity) will nearly agree, as experience proves. 6. The most general proportion between the power and the effect is as 10 to 3; the extremes are 10 to 3, 2, down to 10, 2, 8. 7. The proportion of velocity between the water and the wheel is usually as 5 to 2. 8. Although we have no certain maximum of the power of a wheel; that is, what it will carry, and no more; we may generally consider the limits to be, that wheels which work freely with 15, will stop when 20 are opposed to their motion: consequently when 3 is the effect, 4 will stop the work.

Mr. Smeaton found, that in undershot-mills, when he reduced the number of floats from 24 to 12, the effect was reduced one-half, because the water escaped between the floats without touching them; but when he added a circular sweep of such length, that before one float-board quitted it another had entered it, he found the former effect nearly restored.

This mode more particularly applies to breast-wheels, or such as receive the water immediately below the level of the axis. In such the circular trough is indispensable; because the water would not communicate the full effect desirable from the joint operations of velocity and weight. In this kind of wheels it is proper that the float-boards should be confined both at their sides and at their extremities, so that the water may accompany all the way from the head down to the lowest part of the wheel, whence it should draw off with sufficient readiness to allow the succeeding fall to supply its place, without being in the least retarded.

The over-shot wheel is by far the most powerful; both because it receives the water at the very commencement of descent, and that the buckets with which this kind of wheel is ordinarily furnished, retain the power until they gradually discharge their contents, as these buckets successively become inferior parts of the circumference. It should be stated in this place, that much may be effected by allowing the water merely to flow upon the upper part of the wheel, into the superior buckets, whereby an immense auxiliary power is erected as they successively become filled. The more slowly any body descends by the force of gravity, while acting upon any piece of machinery, the more of that force will be spent upon it, and consequently the effect will be the greater. Mr. Smeaton found, that when his wheel, which was two feet in diameter, revolved 20 times in a minute, its effect was greatest: when it made only 18½ turns the effect was irregular: and when so laden as not to make 18 turns, the wheel was overpowered by the load. He found that 30 turns in the minute occasioned a loss of about $\frac{1}{20}$th, and that when turned 30 times in a minute, the diminution of effect was nearly one-fourth of its powers. This proportion may be easily estimated on any wheel of greater extent, by computing the proportion of accumulated power lost by greater velocity than may be sufficient to load the wheel by means of the buckets being filled; observing that the progress of a machine may be so much retarded as to cause the effect to be irrelevant of the purpose, although the machine may be kept in motion.

The maximum load for an overshot wheel is that which reduces the circumference of the wheel to its proper velocity, which is known by dividing the effect it ought to produce in a given time by the space intended to be described by the circumference of the wheel in the same time. The quotient will be the resistance overcome at the circumference of the wheel; it is equal to the load required, including the friction and the resistance of the machinery. So much, however, depends on the proper precautions for reducing the friction

of the several moving parts, that too much stress cannot be laid on that highly important consideration.

The following is a description of a corn-mill of the most common sort. See plate XXXIV. AB, fig. 1, is the water-wheel, which is generally from 18 to 24 feet in diameter, reckoned from the outermost edge of any float-board at A, to that of the opposite one at B. The water, striking on the floats of this wheel, drives it round, and gives motion to the mill. The wheel is fixed upon a very strong axis or shaft C, one end of which rests on D, and the other on E, within the mill-house.

On this shaft, or axis, and within the mill-house, is a wheel F, about eight or nine feet in diameter, having cogs all round, which work in the upright staves, or rounds of a trundle G. This trundle is fixed upon a strong iron axis, called the spindle, the lower end of which turns in a brass foot fixed at H, in a horizontal beam H, called the bridge-tree; and the upper end of the spindle turns in a wooden bush fixed into the nether mill-stone, which lies upon beams in the floor I. The top of the spindle above the bush is square, and goes into a square hole in a strong iron cross, *abcd*, fig. 2, called the rynd; under which, and close to the bush, is a round piece of thick leather upon the spindle, which it turns round at the same time as it does the rynd.

The rynd is let into grooves in the under surface of the running mill-stone K, and so turns it round in the same time that the trundle G is turned round by the cog-wheel F. This mill-stone has a large hole quite through its middle, called the eye of the stone, through which the middle part of the rynd and upper end of the spindle may be seen; whilst the four ends of the rynd lie below the stone in their grooves. One end of the bridge-tree, which supports the spindle, rests upon the wall, whilst the other is let into a beam, called the brayer LM.

The brayer rests in a mortice at L; and the other end M hangs by a strong iron rod N, which goes through the floor I, and has a screw-nut on its top at O; by the turning of which nut, the end M of the brayer is raised or depressed at pleasure; and consequently the bridge-tree and the upper mill-stone. By this means the upper mill-stone may be set as close to the under one, or raised as high from it, as the miller pleases. The nearer the mill-stones are to each other, the finer the corn is ground; and the more remote from one another, the coarser. The upper mill-stone is inclosed in a round box, which does not touch it any where, and is about an inch distant from its edge all round. On the top of this box stands a frame for holding the hopper P, to which is hung the shoe Q, by two lines fastened to the hinder part of it, fixed upon hooks in the hopper, and by one end of the string R fastened to the fore part of it; the other end being twisted round the pin S. As the pin is turned one way, the string draws up the shoe closer to the hopper, and so lessens the aperture between them; and as the pin is turned the other way, it lets down the shoe, and enlarges the aperture.

There is a square hole in the top of the spindle, in which is put the feeder F, fig. 2; this feeder, as the spindle turns round, jogs the shoe three times in each revolution, and so causes the corn to run constantly down from the hopper through the shoe into the eye of the mill-stone, where it falls upon the top of the rynd, and is by the motion of the rynd, and the leather under it thrown below the upper stone, and ground between it and the lower one. The violent motion of the stone creates a centrifugal force in the corn going round with it, by which means it gets farther and farther from the centre, as in a spiral, in every revolution, until it is quite thrown out, and being then ground, it falls through a spout, called the mill-eye, into a trough placed to receive it.

When the mill is fed too fast, the corn bears up the stone, and is ground too coarse; and, besides, it clogs the mill, so as to make it go too slow. When the mill is too slowly fed, it goes too fast; and the stones, by their attrition, are apt to strike fire. Both these inconveniences are avoided by turning the pin S backward or forward, which draws up or lets down the shoe; and thus regulates the feeding, as the miller sees convenient.

The quantity of power sufficient to turn a heavy mill-stone, is but very little more than what is necessary to turn a light one; for as it is supported upon the spindle by the bridge-tree, and the end of the spindle that turns in the brass foot therein being but small, the difference arising from the weight is but very inconsiderable in its action against the power or force of the water. The spindle of the mill-stone being thus supported, the upper mill-stone is allowed a slight vertical motion, by which movement, the heavier the stones are, the more forcibly is the corn wedged in between them.

In order to cut and grind the corn, both the upper and under mill-stones have channels or furrows cut into them, proceeding obliquely from the centre to the circumference. And these furrows are cut perpendicularly on one side, and obliquely on the other, which gives each furrow a sharp edge; and in the two stones, they come against one another, like the edges of a pair of scissars; and so cut the corn, to make it grind the easier, when it falls upon the places between the furrows.

The grinding surface of the under stone is a little convex from the edge to the centre, and that of the upper stone a little concave; so that they are farthest from one another in the middle, and approach gradually nearer towards the edges. By this means the corn, at its first entrance between the stones, is only bruised; but as it goes farther on towards the circumference or edge, it is cut smaller and smaller; and, at last, finely ground, just before it comes out from between them.

When the furrows become blunt and shallow by wearing, the running-stone must be taken up, and both stones new drest with a chisel and hammer. The bush must embrace the spindle quite close, to prevent any shake in the motion, which would make some parts of the stones grate and fire against each other; whilst the other parts of them would be too far asunder, and by that means spoil the meal. Whenever the spindle wears the bush, so as to begin to shake in it, the stone must be taken up, and a chisel driven into several parts of the bush; and when it is taken out, wooden

wedges must be forced into the holes; by which means the bush will be made to embrace the spindle again, close all round. When any accident of this kind happens, the perpendicular position of the spindle must be restored, by adjusting the bridge-tree with proper wedges put between it and the brayer. It often happens that the rynd is a little wrenched in laying down the upper stone upon it, or is made to sink a little lower on one side of the spindle than on the other. But this is easily rectified, by raising the stone a little with the lever, and putting bits of paper, cards, or thin chips, between the rynd and the stone.

A less quantity of water will turn an overshot-mill (where the wheel has buckets instead of float-boards) than a breast-mill, where the fall of water seldom exceeds half the height of the wheel; so that where there is but a small quantity of water, and a fall great enough for the wheel to lie under it, the bucket, or overshot, wheel, is always used: but where there is a large body of water with a little fall, the breast, or float-board wheel, must be used. Where the water runs only upon a small declivity, it can act but slowly upon the under part of the wheel; in which case, the motion of the wheel will be slow: and therefore the floats ought to be very long, though not high, that a large body of water may act upon them: so that what is wanting in velocity may be made up in power, and then the cog-wheel may have a greater number of cogs, in proportion to the rounds in the trundle, in order to give the mill-stone a sufficient degree of velocity.

It was the opinion of Smeaton, that the powers necessary to produce the same effect on an undershot-wheel, a breast-wheel, and an overshot wheel, must be to each other as the numbers 2.4, 1.75, and 1.

Practical Rules for the Construction of Mills.

Measure the perpendicular height of the fall of water, in feet, above that part of the wheel on which the water begins to act, and call that the height of the fall.

Multiply this constant number 64,2882 by the height of the fall in feet, and the square root of the product will be the velocity of the water at the bottom of the fall, or the number of feet that the water there moves per second.

Divide the velocity of the water by three, and the quotient will be the velocity of the float-boards of the wheel, or the number of feet they must each go through in a second, when the water acts upon them so as to have the greatest power to turn the mill.

Divide the circumference of the wheel in feet by the velocity of its float in feet per second, and the quotient will be the number of seconds in which the wheel turns round.

By this last number of seconds divide 60, and the quotient will be the number of turns of the wheel in a minute.

Divide 120 (the number of revolutions a mill-stone four feet and a half diameter ought to have in a minute) by the number of turns of the wheel in a minute, and the quotient will be the number of turns the mill-stone ought to have for one turn of the wheel. Then, as the number of turns of the wheel in a minute is to the number of turns of the mill-stone in a minute, so must the number of staves in the trundle be to the number of cogs in the wheel, in the nearest whole numbers that can be found.

We shall here add a brief description of a water-mill invented by Dr. Barker, which is extremely simple in its construction, having neither wheel nor trundle. The power of a mill of this nature must obviously depend on the height of the column of water which presses on the horizontal piece at bottom.

This machine is represented by fig. 2, in which, A is a pipe or channel that brings water to the upright tube B. The water runs down the tube, and thence into the horizontal trunk C, and runs out through holes at *d* and *e* near the ends of the trunk on the contrary sides thereof.

The upright spindle D is fixed in the bottom of the trunk, and screwed to it below by the nut *g*; and is fixed into the trunk by two cross bars at *f*: so that, if the tube B and trunk C be turned round, the spindle D will be turned also.

The top of the spindle goes square into the rynd of the upper-mill-stone H, as in common mills; and as the trunk, tube, and spindle turn round, the mill-stone is turned round thereby. The lower, or quiescent mill-stone is represented by I; and K is the floor on which it rests, and wherein is the hole L for letting the metal run through, and fall down into a trough which may be about M. The hoop or case that goes round the mill-stone rests on the floor K, and supports the hopper, in the common way. The lower end of the spindle turns in a hole in the bridge-tree GF, which supports the mill-stone, tube, spindle, and trunk. This tree is moveable on a pin at *h*, and its other end is supported by an iron rod N fixed into it, the top of the rod going through the fixed bracket O, and having a screw nut *o* upon it, above the bracket. By turning this nut forward or backward, the mill-stone is raised or lowered at pleasure.

While the tube B is kept full of water from the pipe A, and the water continues to run out from the ends of the trunk; the upper mill-stone H, together with the trunk, tube, and spindle turns round. But, if the holes in the trunk were stopped, no motion would ensue; even though the tube and trunk were full of water. For, if there were no hole in the trunk, the pressure of the water would be equal against all parts of its sides within. But, when the water has free egress through the holes, its pressure there is entirely removed: and the pressure against the parts of the sides which are opposite to the holes, turns the machine.

The following table, commonly called the mill-wright's table will be found of service to all who have occasion for calculations in machinery.

THE MILLWRIGHT'S TABLE.

Height of the fall of water.	Velocity of the fall of water per second.		Velocity of the wheel per second.		Revolutions of the wheel per minute.		Revolutions of the mill-stone for one of the wheels		Cogs in the wheel, and staves in the trundle.		Revolutions of the mill-stone per minute by these staves and cogs.	
Feet.	Feet.	100 parts of a foot.	Feet.	100 parts of a foot.	Revolutions.	100 parts of a rev.	Revolutions.	100 parts of a rev.	Cogs.	Staves.	Revolutions.	100 parts of a rev
1	8	02	2	67	2	83	42	40	254	6	119	84
2	11	34	3	78	4	00	30	00	210	7	120	00
3	13	89	4	63	4	91	24	44	196	8	120	28
4	16	04	5	35	5	67	21	16	190	9	119	74
5	17	93	5	98	6	34	18	92	170	9	119	68
6	19	64	6	55	6	94	17	28	156	9	120	20
7	21	21	7	07	7	30	16	00	144	9	120	00
8	22	68	7	56	8	02	14	96	134	9	119	34
9	24	05	8	02	8	51	14	10	140	10	119	14
10	25	35	8	45	8	97	13	38	134	10	120	18
11	26	59	8	86	9	40	12	76	128	10	120	32
12	27	77	9	26	9	82	12	22	122	10	119	80
13	28	91	9	64	10	22	11	74	118	10	120	36
14	30	00	10	00	10	60	11	32	112	10	118	72
15	31	05	10	35	10	99	10	98	110	10	120	96
16	32	07	10	69	11	34	10	58	106	10	120	20
17	33	06	11	02	11	70	10	26	102	10	119	34
18	34	32	11	31	12	02	9	98	100	10	120	20
19	34	92	11	65	12	37	9	70	98	10	121	22
20	35	86	11	95	12	68	9	46	94	10	119	18
1	2		3		4		5		6		7	

To construct a mill by this table, find the height of the fall of water in the first column, and against that height, in the sixth column, you have the number of cogs in the wheel, and staves in the trundle, for causing the mill-stone four feet six inches diameter, to make about 120 revolutions in a minute, as near as possible, when the wheel goes with one-third part of the velocity of the water. And it appears by the 7th column, that the number of cogs in the wheel, and staves in the trundle, are so near the truth for the required purpose, that the least number of revolutions of the mill-stone in a minute is 118, and the greater number never exceeds 121; which is according to the speed of some of the best mills. One of the most usual communications of motion in machinery, is by means of toothed wheels acting on each other. It is of the greatest consequence to have the teeth so formed, that the pressure by which one of them urges the other round its axis is constantly the same. The ends of the teeth should never be formed of parts of circles, but of a particular curve, called the epicycloid, which is formed by moving the circle, called the generating circle, round the circumference of another circle while it turns also round its own centre; then any point will describe an epicycloid.

Emerson observes, that the teeth of wheels ought not to act upon each other before they arrive at the line which joins their centres; and though the inner or under sides of the teeth may be of any form, yet it is better to make both sides alike, which will serve to make the wheel turn backwards. The more teeth that work together the better; at least one tooth should always begin before the other has done working. The teeth ought to be so disposed as not to trouble or hinder one another before they begin to work.

Mills, *wind*, are, in their general construction, much the same as water mills; adverting to the difference of the power by which they are acted upon. The external apparatus consists chiefly of the sails, or vanes, which are commonly four, placed in nearly a vertical position, and giving, as they turn, a rotatory motion to an axis inclining but little from the horizon.

Mills, *copper* and *brass*, are almost invariably worked by water, having large wheels that give immediate action to hammers of great weight; these beat out the large slabs and bricks of metal into various forms, such as kettles, coppers, boilers, &c. and roll out sheets for various purposes, but especially for coppering the bottoms of ships. This process is effected by passing the heated metal between two cast-iron cylinders, of about a foot diameter, which, having contrary motions, draw it through a small interval left between them: and by reducing the thickness, give greater surface to the sheet.

Mills, *silk*, *cotton*, &c. require much delicacy in their construction; their principal movements depend on the same principles as those of the mills described in the plate; the more minute parts, such as the bobins, &c. being moved by means of one or more leather straps passing them in close contact, so as to occasion them to revolve with an astonishing degree of velocity.

Mills, *saw*, though extremely simple in their parts, require the greatest care in their formation. The saws which are moved by cranks, must be set with most scrupulous exactness

In most instances the timber is brought forward to the saw by means of a small toothed wheel, and an axle whereupon the rope that pulls the timber is gradually coiled.

MILLS, *flax*, are generally worked by cattle; their construction is simple; the essential parts being the hackle, which combs the flax; and the scutcher, which strikes it: both tend to clearing away the coarser and unequal fibres, and to prepare the material for being spun either by hand, or by means of machinery.

Having said thus much on the subject of mill-work, we beg leave to refer those of our readers who may be in search of abstruse knowledge, to Olinthus Gregory's work on the Theory of Mechanics; and to the excellent practical treatise of the late Mr. Smeaton.

MILLEPES. See ONISCUS.

MILLEPORA. See MADREPORE, ZOOPHITES.

MILLERA, a genus of the syngenesia polygamia necessaria class of plants, the compound flower of which is radiated; there is scarcely any visible receptacle of the seeds, which are single after each particular flower, and have no pappus or down. There are three species.

MILLET. See MILLIUM and PANICUM.

MILLET-GRASS. See LILIUM.

MILLING. See FULLING.

MILLION, in arithmetic, the number of ten hundred thousand, or a thousand times a thousand.

MILLREE, a Portuguese gold coin, equal to 5*s.* 7½*d.* of our money.

MIMOSA, the *sensitive plant*, a genus of the polygamia order, in the monœcia class of plants, and in the natural method ranking under the 33d order, lomentaceæ. The hermaphrodite calyx is quinquedentate; the corolla quinquefid; there are five or more stamina, one pistil, and a legumen; the male calyx is quinquedentate; the corolla quinquefid, with five, ten, or more stamina.

The name mimosa signifies "mimic;" and is given to this genus on account of the sensibility of the leaves, which, by their motion, mimic or imitate the motion of animals. This genus comprises 85 different species, all natives of warm climates. The sensitive kinds are exceedingly curious plants in the very singular circumstances of their leaves receding rapidly from the touch, and running up close together; and in some sorts the footstalks and all are affected, so as instantly to fall downward as if fastened by hinges, which last are called humble sensitives. They have all winged leaves, each wing consisting of many small pinnæ. The following are the most remarkable:

1. The *sensitiva*, or common sensitive humble plant, rises with an under-shrubby prickly stem, branching six or eight feet high, armed with crooked spines. This is somewhat of the humble sensitive kind; the leaves, footstalks and all, receding from the touch, though not with such facility as in some of the other sorts.

2. The *pudica*, or bashful humble plant, rises with an under-shrubby, delineated, prickly stem, branching two or three feet round, armed with hairy spines. This is truly of the humble sensitive kind; for by the least touch the leaves instantly recede, contract close, and together with the footstalk, quickly decline downward, as if ashamed at the approach of the hand.

3. The *scandens*, cacoons, or mafootoo wyth, is frequent in all the upland valleys and woodlands on the north side of Jamaica. It climbs up the tallest trees, and spreads itself in every direction by means of its cirrhi, or claspers, so as to form a complete arbour, and to cover the space of an English acre from one root, five inches broad, jointed, and containing 10 or 15 seeds. These seeds are brown, shining, flattened, and very hard, and called cacoons.

4. The *catechu*, according to Mr. Ker, grows only to 12 feet in height, and to one foot in diameter; it is covered with a thick, rough, brown bark, and towards the top divides into many close branches: the leaves are bipinnated, or doubly winged, and are placed alternately upon the younger branches: the partial pinnæ are nearly two inches long, and are commonly from 15 to 30 pair, having full glands inserted between the pinnæ: each wing is usually furnished with about 40 pair of pinnulæ or linear lobes, beset with short hairs: the spines are short. From this tree, which grows plentifully on the mountainous parts of Indostan, where it flowers in June, is produced the officinal drug long known in Europe by the name of terra japonica.

5. The *nilotica*, or true Egyptian acacia, rises to a greater height than the preceding. The fruit is a long pod, resembling that of the lupin, and contains many flattish, brown seeds. It is a native of Arabia and Egypt, and flowers in July. Although the mimosa nilotica grows in great abundance over the vast extent of Africa, yet gum arabic is produced chiefly by those trees which are situated near the equatorial regions; and we are told that in Lower Egypt the solar heat is neversufficiently intense for this purpose. The gum exudes in a liquid state from the bark of the trunk and branches of the tree, in a similar manner to the gum which is often produced upon the cherry-trees, &c. in this country; and by exposure to the air it soon acquires solidity and hardness.

MIMULUS, *monkey flower*, a genus of the didynamia angiospermia class of plants, with double stigmata, and a ringent monopetalous flower; the fruit is a bilocular capsule, with several seeds in each cell. There are three species.

MINA, in Grecian antiquity, a money of account, equal to a hundred drachms.

MINE, a deep pit under ground, whence various kinds of minerals are dug out; but the term is more particularly applied to those which yield metals. Where stones only are procured, the appellation of quarries is universally bestowed upon the places from which they are dug out, however deep they may be. Mines in general, then, may be said to be veins or cavities within the earth, whose sides receding from, or approaching nearer to each other, make them of unequal breadths in different places, sometimes forming larger spaces, which are called holes; they are filled, with substances, which, whether metallic or of any other nature, are called the lodes; when the substances forming these lodes are reducible to metal, the lodes are by the miners said to be alive; otherwise they are called dead lodes. In Cornwall and Devon the lodes always hold their course from eastward to westward, though in other parts of England, they frequently run from north to south. The sides of the lode never bear in a perpendicular, but constantly

The lode is frequently intercepted by the crossing of a vein of earth, or stone, or some different metallic substance, in which case it generally happens that one part of the lode is moved a considerable distance to the one side. This transient lode is by the miners called flooking; and the part of the lode which is to be moved, is said to be heaved. According to Dr. Nichols's observations upon mines, they seem to be, or to have been, the channels through which the waters pass within the earth, and, like rivers, have their small branches opening into them, in all directions. Most mines have streams of water running through them; and when they are found dry, it seems to be owing to the waters having changed their course as being obliged to it, either because the lode has stopped up the ancient passages, or that some new and more easy ones are made. Many mines have been discovered by accident: a torrent first laid open a rich vein of the silver mine at Friberg in Germany; sometimes a violent wind, by blowing up trees, or overturning the parts of rocks, has discovered a mine; the same has happened by violent showers, earthquakes, thunder, the firing of woods, or even the stroke of a ploughshare.

The principal signs of a latent metallic vein, seem reducible to general heads, such as, 1. The discovery of certain mineral waters. 2. The discoloration of the trees or grass of a place. 3. The finding of pieces of ore on the surface of the ground. 4. The rise of warm exhalations. 5. The finding of metallic sands, and the like. All which are so many encouragements for making a stricter search near the places where any thing of this kind appears; whence rules of practice might be formed for reducing this art to a greater certainty. But when no evident mark of a mine appears, the skilful mineralist usually bores into the earth, in such places as from some analogy of knowledge, gained by experience, or by observing the situation, course, or nature of other mines, he judges may contain metal.

After the mine is found, the next thing to be considered is, whether it may be dug to advantage. In order to determine this, we are duly to weigh the nature of the place, and its situation, as to wood, water, carriage, healthiness, and the like, and compare the result with the richness of the ore, the charge of digging, stamping, washing, and smelting.

The form and situation of the spot ought to be particularly considered. A mine must either happen, 1. In a mountain. 2. In a hill. 3. In a valley, or, 4. In a flat. But mountains and hills are dug with much greater ease and convenience, chiefly because the drains and burrows, that is, the adits, or avenues may be here readily cut out, both to drain the water and to form gangways for bringing out the ore, &c. In all the four cases we are to look out for the veins which the rains, or other accidental things may have laid bare; and if such a vein be found, it may often be proper to open the mine at that place, especially if the vein prove tolerably large and rich: otherwise the most commodious place for situation is to be chosen for the purpose, viz. neither on a flat nor on the tops of mountains, but on the sides. The best situation for a mine, is a mountainous, woody, wholesome spot; of a safe easy ascent, and bordering on a navigable river.

Mine, in military affairs, is also a subterraneous cavity made according to the rules of art, in which a certain quantity of powder is lodged, which by its explosion blows up the earth above it. It has been found by experiment that the figure produced by the explosion is a paraboloid; and that the centre of the powder, or charge, occupies the focus. The place where the powder is lodged is called the chamber of the mine, or fornean. The passage leading to the powder is called the gallery.

The line drawn from the centre of the chamber, perpendicular to the nearest surface of the ground, is called the line of least resistance. The pit or hole, made by springing the mine, is called the excavation. The fire is communicated to the mine by a pipe or hose, made of coarse cloth, whose diameter is about one inch and a half, called the saucisson (for the filling of which near half a pound of powder is allowed to every foot), extending from the chamber to the entrance of the gallery; to the end of which is fixed a match, that the miner who sets fire to it may have time to retire before it reaches the chamber. To prevent the powder from contracting any dampness, the saucisson is laid in a small trough, called an auger, made of boards, three inches and a half broad, joined together lengthwise, with straw in it, and round the saucisson, with a wooden cover nailed upon it.

Galleries and chambers of mines.—The galleries made within the fortification before the place is attacked, and from which several branches are carried to different places, are from three to four feet, or four and a half wide, and five feet or five and a half high. The earth is supported from falling in by arches and walls, or wooden frames or props. The chamber is generally of a cubical form, large enough to hold the wooden box, which contains the powder. The chamber is sunk something lower than the gallery, if the soil permits; but where water is to be apprehended, it must be made higher than the gallery.

Quantities of powder to charge mines.—Before any calculation can be made of the proper charge for a mine, the density and tenacity of the soil in which it is to be made must be ascertained, either by experiment or otherwise. The density is determined by weighing a cubic foot (or any certain quantity) of the soil; but the tenacity can only be determined by making a mine. The following table contains experiments in six different soils, which may be of some assistance to form a judgment of the nature of the soil, when an actual experiment cannot be had.

	Density.	Tenacity.
Nature of the soil.	Weight of 1 Cubic foot.	Quantity of powder to raise 1 cub. fathom
1. Loose earth or sand	95 pds.	8 pds.
2. Common light soil	124	10
3. Loam, or strong soil	127	12¼
4. Potters' clay, or stiff soil	135	13½
5. Clay mixed with stones	160	16
6. Masonry	05	21½

Loading and stopping of mines. The gallery and chamber being ready to be loaded, a strong box of wood is made of the size and figure of the chamber, being about one-third, or one-fourth bigger than is required for containing the necessary quantity of powder: against the sides and bottom of the box is put some straw; and this straw is covered over with empty sand-bags, to prevent the powder from contracting any dampness: a hole is made in the side next the gallery, near the bottom, for the saucisson to pass through; which is fixed to the middle of the bottom by means of a wooden peg, to prevent its loosening from the powder; or that, if the enemy should get to the entrance, he may not be able to tear it out. This done, the powder is brought in sand-bags, and thrown loose in the box, and covered also with straw and sand-bags; upon this is put the cover of the box, pressed down very tight with strong props; and, to render them more secure, planks are also put above them, against the earth, and wedged in as fast as possible. This done, the vacant spaces between the props are filled up with stones and dung, and rammed in the strongest manner: the least neglect in this work will considerably alter the effect of the mine. The auget is then laid from the chamber to the entrance of the gallery, with some straw at the bottom, and the saucisson laid in it, with straw over it: lastly, it must be shut with a wooden cover nailed upon it. The gallery is stopped up with stones, earth, and dung, well rammed, six or seven feet further from the chamber than the length of the line of least resistance.

MINERAL WATERS. See WATERS.

MINERALOGY, is that science which treats of the solid and inanimate materials of which our globe consists; and these are usually arranged under four classes: the earthy, the saline, the inflammable, and the metallic, which are thus distinguished:

1. The earthy minerals compose the greater part of the crust of the earth, and generally form a covering to the rest. They are not remarkable for being heavy, brittle, or light-coloured. They are little disposed to chrystallize, are uninflammable in a low temperature, insipid, and without much smell.

2. The saline minerals are commonly moderately heavy, soft, sapid, and possess some degree of transparency.

3. The inflammable class of minerals is light, brittle, mostly opaque, of a yellow brown, or black colour, seldom chrystallize, and never feel cold.

4. Metallic minerals are characterized by being heavy, generally opaque, tough, malleable, cold, not easily inflamed, and by exhibiting a great variety of colours, of a peculiar lustre.

Under each of these classes are various genera, species, sub-species, and kinds, which will be noticed in order. Sometimes, as in the vegetable kingdom, we find a strict affinity between different species of minerals, and in that case they are said to belong to the same family; but in mineralogy, one class does not always blend with another in a chemical point of view, or furnish that beautiful gradation and almost imperceptible union which is to be traced in the other kingdoms of nature. As the external characters are of the first importance in facilitating our acquaintance with minerals, we shall briefly explain this subject, before we proceed to the classification of the different substances.

Of the external Characters of Minerals.

The external characters of minerals are either generic or specific. The generic characters are certain properties of minerals, without any reference to their differences, as colour, lustre, weight, &c.; and the differences between these properties form the specific characters.

Generic characters may be general or particular. In the first division are comprehended those that occur in all minerals, in the last those that are found only in particular classes of minerals.

The particular generic external characters are thus advantageously arranged:

1. Colour.

2. Cohesion of particles; distinguished into solid, friable, and fluid.

In solid minerals are to be regarded the external shape, the external surface, and the external lustre. When broken, the lustre of the fracture, the fracture itself, and the shape of the fragments, are to be noticed. In distinct concretions, regard must be paid to the shape of the concretions, their surface, their lustre, transparency, streak, and soiling. All these may be ascertained by the eye. By the touch, we may discover the hardness of minerals, their tenacity, frangibility, flexibility, their unctuosity, coldness, weight, and their adhesion to the tongue. By the ear we distinguish their sound, and by the smell and taste the qualities which these two senses indicate.

In friable minerals, external shape, lustre, aspect of particles, soiling, and degree of friability, are to be attended to.

In fluid minerals the lustre, transparency, and fluidity, are principal objects to be regarded.

The specific external characters of minerals are founded on the distinctions and varieties of the two great generic divisions. And first, of colours, the names of which are derived from certain bodies in which they most generally occur, either in a natural or artificial state, or from different mixtures and compositions of both.

I. Colour.

1. White. This may be snow-white, reddish-white, yellowish-white, silver-white, greyish-white, greenish-white, milk-white, or tin-white.

2. Grey. Lead-grey, blueish-grey, pearl-grey, reddish-grey, smoke-grey, greenish-grey, yellowish-grey, steel-grey, and ash-grey.

3. Black. Greyish-black, brownish-black, dark-black, iron-black, greenish-black, and blueish-black.

4. Blue. Indigo-blue, Prussian-blue, lavender-blue, smalt-blue, sky-blue.

5. Green. Verdigis-green, celaden green, mountain-green, emerald-green, leek-green, apple-green, grass-green, pistachio-green, asparagus-green, olive-green, blackish-green, canary-green.

6. Yellow. Sulphur-yellow, lemon-yellow, gold-yellow, bell-metal-yellow, straw-yellow, wine-yellow, Isabella-yellow, ochre-yellow orange-yellow, honey-yellow, wax-yellow, and brass-yellow.

7. **Red.** Morning-red, hyacinth-red, brick-red, scarlet-red, copper-red, blood-red, carmine-red, cochineal-red, crimson-red, columbine-red, flesh-red, rose-red, peach-blossom-red, cherry-red, brownish-red.

8. **Brown.** Reddish-brown, clove-brown, hair-brown, yellowish-brown, tombac-brown, wood-brown, liver-brown, blackish-brown.

Besides these distinctions, colours may be clear, dark, light, or pale; they may have a tarnished appearance, a play, a changeability, an iridescence, an opalescence, a permanent alteration, and a delineation of figure or pattern, such as dotted, spotted, clouded, flamed, striped, veined, dendritic, or ruiniform.

II. COHESION OF PARTICLES.

Minerals are divided into, 1. Solid, or such as have their parts coherent, and not easily moveable; 2. Friable, or that state of aggregation in which the particles may be overcome by simple pressure of the finger; and, 3. Fluid, or such as consist of particles which alter their place in regard to each other by their own weight.

1. *Solid Minerals.*

External aspect has three things to be regarded, 1. The shape; 2. The surface; and 3. The lustre. The external shape again may be common, particular, regular, or extraneous; and hence arise the specific differences.

1. The common external shape may be massive; disseminated coarsely, minutely, or finely; in angular pieces, sharp cornered or blunt cornered; in grains, large, coarse, small, fine, angular, flat, round; in plates, thick or thin; in membranes or flakes, thick, thin, or very thin.

The particular external shape may be longish, as dentiform, filliform, capillary, reticulatic, dendritic, coralliform, stalactitic, cylindrical, tubiform, claviform, or fruticose; roundish, as globular, spherical, ovoidal, spheroidal, amygdaloidal, botryoidal, reniform, tuberose, or fused-like; flat, as specular, or in leaves; cavernous, as cellular in various forms, with impressions, perforated, corroded, amorphous, or vesicular; entangled, as ramose, &c.

In the regular external shape or chrystallization are to be regarded its genuineness, according to which it may be either true or suppositious; its shape, made up of planes, edges angles, in which are to be observed the fundamental figure and its parts, the kind of fundamental figure, the varieties of each kind of fundamental figure, with their accidents and distinctions, and the alterations which the fundamental figure undergoes by truncation, by bevelment, by acumination, or by a division of the planes. There are a variety of figures under each of these subdivisions. It must be remarked also, that the external shape may be extraneous, or derived from the animal and vegetable kingdoms, as in fossils and petrifications.

2. The external surface contains several varieties of distinctions. It may be uneven, granulated, rough, smooth, or streaked in various ways and directions.

3. The external lustre is the third generic external character, and is of much importance to be attended to. In this we have to consider the intensity of the lustre, whether it is splendent, shining, glistening, glimmering, or dull; next the sort of lustre, whether metallic or common. The latter is distinguished into semimetallic, adamantine, pearly, resinous, and vitreous.

Aspect of the Fracture of solid Minerals.

After the external aspect, the fracture forms no inconsiderable character in minerals. Its lustre may be determined as in the external lustre; but the fracture itself admits of great varieties. It may be compact splintery, coarsely splintery, finely splintery, even, conchoidal, uneven, earthy, hackly. If the fracture is fibrous, we are to consider the thickness of the fibres, if coarse or delicate; the direction of the fibres, if straight or curved; and the position of the fibres, if parallel or diverging.

In the radiated fracture we are to regard the breadth of the rays, their direction, their position, their passage or cleavage. In the foliated fracture, the size of the folia, their degree of perfection, their direction, position, aspect of their surface, passage or cleavage, and the number of cleavages, are to be noted.

The shape of the fragments may also be very various-regular, as cubic, rhomboidal, trapezoidal, &c. or irregular, as cuneiform, splintery, tabular, indeterminately angular.

Aspect of the distinct Concretions.

The shape of the distinct concretions forms very prominent external characters. They may be granular, different in shape, or in magnitude; they may be lamellar, distinct, concretions, differing in the direction of the lamellæ, in the thickness, with regard to shape, and in the position.

The surface of the distinct concretions may be smooth, rough, streaked, or uneven; as for their lustre, it may be determined in the same manner as the external lustre.

General Aspect as to Transparency.

Minerals, as is well known, have different degrees of transparency, which may be considered among their external characters.—They may be transparent, semitransparent, translucent, translucent at the edges, or opaque.

The Streak.

The colour of this external character may be either similar or different. It is presented to us when a mineral is scraped with the point of a knife: and is similar, when the powder that is formed is of the same colour with the mineral, as in chalk; or dissimilar or different, as in cinnabar, orpiment, &c.

The Soiling or Colouring

Is ascertained by taking any mineral substance between the fingers, or drawing it across some other body. It may soil strongly, as in chalk, slightly, as in molybdena, or not at all, which is a quality belonging to most of the solid minerals. All the preceding external characters are recognized by the eye.

External Characters from the Touch.

These are eight in number, and are not destitute of utility to the mineralogical student. 1. Hardness; 2. Tenacity; 3. Frangibility; 4. Flexibility; 5. Adhesion to the tongue; 6. Unctuosity; 7. Coldness; 8 Weight.

Hardness may be tried by a capacity to resist the file, yielding a little to it, being semi-hard, soft, or very soft. Tenacity has different degrees, in substances being brittle, sectile or mild, or ductile. The frangibility consists in minerals being very difficultly frangible, difficultly frangible, easily frangible, or very easily frangible. The flexibility is proved by being simply flexible, elasticly flexible, commonly flexible, or inflexible. The adhesion to the tongue may be strongly adhesive, pretty strongly, weakly, very weakly, or not at all. Unctuosity may be meagre, rather greasy, greasy, or very greasy. Coldness is subdivided into cold, pretty cold, rather cold. Weight may be distinguished into swimming or supernatant, light, rather light, heavy, very heavy. The three last divisions from the touch, are in the Wernerian system regarded as anomalous; but they seem properly to be classed under this head.

External Characters from the Sound or Hearing.

The different kinds of sound which occur in the mineral kingdom are, 1. A ringing sound, as in native arsenic and thin splinters of hornstone; 2. A grating sound, as in fresh-burnt clay; 3. A creaking sound, as that of natural amalgam.

2. *Friable Minerals.*

The external characters drawn from minerals of this class are derived, first, from the external shape, which may be massive, disseminated, thinly, coating, spumous, or dendritic: secondly, from the lustre, regarded under its intensity, whether glimmering or dull, and its sort, whether common glimmering or metallic glimmering: thirdly, from the aspect of the particles, as being dusty or scaly: fourthly, from soiling or colouring, as strongly or lightly: and lastly, from the friability, which may be loose or cohering.

3. *Fluid Minerals.*

Of external characters drawn from fluid minerals, there are only two kinds, which include three varieties: 1. The lustre, which is either metallic, as in mercury, or resinous, as in rock oil. 2. The transparency, which is transparent, as in naphtha; turbid, as in mineral oil; or opaque, as in mercury. 3. The fluidity, which may be fluid, as in mercury, or viscid, as in mountain tar.

External Characters from the Smell.

These may be spontaneously emitted and described, as bituminous, faintly sulphureous, or faintly bitter; or they may be produced by breathing on, and yield a clay-like smell; or they may be excited by friction, and smell urinous, sulphureous, garlick-like, or empyreumatic.

External Character from the Taste.

This character prevails chiefly in the saline class, and it contains the following varieties: a sweetish taste, sweetish astringent, styptic, saltly bitter, saltly cooling, alkaline, or urinous.

Having now given a synoptical view of the external characters of minerals, we shall proceed to their classification, and in this we shall chiefly follow the names and arrangement of professor Jameson

CLASS I.

EARTHY FOSSILS.

First Genus. DIAMOND.

Diamond.

This precious stone has great variety of shades, exhibiting a beautiful play of colours. It occurs in indeterminately angular and completely spherical grains, which present planes of chrystallization, or are actually chrystallized. Its fundamental chrystal is the octaedron, which passes into various forms. It is hard in the highest degree, brittle, not very difficultly frangible, and has a specific gravity of 3.600.

The diamond has, by modern experiments, been proved to be nearly pure carbon, and begins to burn at 14° or 15° of Wedgewood.

Second Genus. ZIRCON.

First Species. *Zircon.*

The prevailing colour is grey, but it occurs likewise green, blue, red, yellow, and brown, with various intermediate tints.

It is found most commonly in roundish angular pieces, with rounded angles and edges. When chrystallized, the figure is generally a rectangular four-sided prism.

Second Species. *Hyacinth.*

The chief colour is red, passing to reddish-brown, and to orange-yellow. The figure a rectangular four-sided prism, flatly acuminated by four planes, which are set in the lateral edges. Of this figure, however, several varieties occur.

The chrystals are generally small, and always imbedded. The lateral planes smooth, and externally shining. Internally it is splendent and glassy, inclining somewhat to resinous.

Third Genus. FLINT.

First Species. *Chrysoberyl.*

The prevailing or general colour is asparagus-green, passing into a variety of allied shades. It exhibits a milk-white light; occurs in roundish and angular grains, which sometimes approach in shape to the cube. It is seldom chrystallized; but when in this state, it commonly presents a longish six-sided table, having truncated lateral edges, and longitudinally streaked lateral planes. The chrystals are small, externally shining, and internally splendent. It is hard, brittle, not very easily frangible, with a specific gravity of 3.600. Without addition, it is infusible.

Second Species. *Chrysolite.*

The chief colour is pistachio-green, of all degrees of intensity. It occurs in original angular sharp-edged pieces, with a rough, scaly, splintery surface, and when chrystallized, exhibits a broad rectangular four-sided prism, with its lateral edges sometimes truncated, sometimes bevelled, and acuminated by six planes. The external surface of the chrystals is splendent, internally splendent, and vitreous.

Third Species. *Olivine.*

The colour is generally asparagus-green, of various degrees of intensity. It is found imbedded also in roundish pieces and grains; and when chrystallized, which is rare, in rectangular four-sided prisms. Internally, it is

shining, varying between glistening and splendent. It is semitransparent, very easily frangible; in a low degree hard, and not particularly heavy. It is nearly infusible without addition. Occurs imbedded in basalt.

Fourth species. Augite.

The general colour is blackish-green. It occurs chiefly in indeterminate angular pieces and roundish grains. Occasionally it is chrystallized, and presents broad rectangular six-sided prisms. The chrystals are mostly small. Internally the lustre is shining, approaching sometimes to splendent. The augite is only translucent, and but faintly transparent. It is hard, not very easily frangible, and not particularly heavy. It is found in basalt, either singly or accompanied with olivine.

Fifth species. Vesuviane.

Its principal colour is dark olive-green, passing into other allied shades. It occurs massive, and often chrystallized in rectangular four-sided prisms. The chrystals are mostly short, and placed on one another. The vesuviane is translucent, hard in a moderate degree, and approaching to heavy. Before the blowpipe it melts without addition. It is found among the exuviæ of Vesuvius, from whence it derives its name in Siberia and Kamtschatka.

Sixth species. Leuzite.

The colours are yellowish and greyish-white. It occurs mostly in original round and angular grains. When chrystallized, it exhibits acute double eight-sided pyramids. Internally it is shining, and approaching to glistening, with a vitreous lustre, inclining somewhat to resinous. The leuzite is translucent and semitransparent. It is hard in a low degree, brittle, easily frangible, and not very heavy.

Seventh species. Melanite.

The general colour is velvet-black. It occurs chrystallized in a six-sided prism. The chrystals are middle sized or small. Externally they are smooth and shining, approaching to splendent; internally shining, inclining to glistening. The melanite is opaque, hard, pretty easily frangible, and not very heavy. It occurs imbedded in rocks of the newest floetz trap formation.

Eighth species. Garnet.

This is divided into two sub-species, the precious garnet and the common garnet.

Ninth species. Pyrope.

The colour is dark-blood red. It occurs in small and middle-sized roundish and angular grains: but never chrystallized. Its lustre is splendent and vitreous. It is completely transparent, hard so as to scratch quartz, and not particularly heavy. It is found imbedded in serpentine in Saxony and Bohemia. In Scotland, it is found in the sand on the sea-shore. It is employed in various kinds of jewellery, and is generally set in a good foil.

Tenth species. Grenatite.

The colour is a dark reddish-brown. It is always chrystallized in broad six-sided prisms. The chrystals are small and middle sized, internally glistening, with a lustre between vitreous and resinous. The grenatite varies from opaque to translucent, is hard, brittle, easily frangible, and not particularly heavy. It is found imbedded in mica slate..

Eleventh species. Spinelle.

The predominant colour is red, which passes on into blue, green, yellow, and brown. It occurs in grains, and likewise chrystallized in octaedrons with several variations. The chrystals are very rarely middle sized. Externally and internally the lustre is splendent and vitreous. It is fusible with borax: occurs in rocks belonging to the newest floetz trap formation. It is used as a precious stone, and considerably valued.

Twelfth species. Sapphire.

The principal colour Berlin blue; but it is found also red, with all the intermediate shades between these two colours. It occurs in small rolled pieces, and chrystallized in double three-side pyramids. The chrystals are small and middle sized. Internally the lustre is splendent and vitreous. Some varieties, when cut, exhibit a star of six rays. The sapphire is hard in the highest degree, but yields to the diamond; it is easily frangible, and rather heavy, having a specific gravity of about 4,000. It is infusible without addition: occurs in rocks of the newest floetz trap formation. This precious stone is found in the utmost beauty in Pegu and Ceylon.

Thirteenth species. Corundum.

See Corundum.

Fourteenth species. Diamond Spar.

The colour is a dark hair brown. It occurs massive, disseminated, in rolled pieces, and chrystallized in six-sided prisms, or very acute six-sided pyramids. Internally, its lustre is splendent, approaching in a slight degree to adamantine. It is translucent on the edges, hard in a high degree, easily frangible, and not particularly heavy. It has hitherto been found only in China. Both this stone and corundum are employed in cutting and polishing hard minerals, and they seem to be nearly allied to each other.

Fifteenth species. Emery.

See Emery.

Sixteenth species. Topaz.

The chief colour is a wine-yellow, of all degrees of intensity. It is found massive, disseminated, and sometimes rolled, but most commonly chrystallized in oblique eight-sided or four-sided prisms, which exhibit several varieties. The chrystals are small and middle-sized, externally splendent; internally splendent, and shining: lustre vitreous. The topaz alternates from translucent to transparent, and is duplicating transparent. It is hard in a high degree, easily frangible, and is not particularly heavy. It is fusible with borax; and some kinds in a gentle heat turn white, and are sometimes sold for diamonds. It is commonly found in veins that traverse primitive rocks.

Seventeenth species. Emerald.

Which see

Eighteenth species. Beryl.

This is divided into two sub-species, the precious and the schorlous beryl. See BERYL.

Nineteenth species. Schorl.

This is divided into sub-species, common schorl and tourmaline.

Twentieth species. Thumerstone.

The colour is commonly clove-brown, of various degrees of intensity. It is occasionally found massive, more frequently disseminated; but generally chrystallized in very flat and oblique rhombs. Externally, its lustre is generally splendent; internally, it alternates from glistening to shining, and is vitreous.

This species alternates from perfectly transparent to weakly translucent. It is pretty hard, very easily frangible, and not particularly heavy. It appears to be peculiar to the primitive mountains.

Twenty-first Species. * *Iron-Flint.*

The colour is a yellowish-brown, bordering on liver-brown. It occurs commonly massive, but also chrystallized in small equiangular six-sided prisms. Externally, its lustre is splendent; internally, shining, and is intermediate between vitreous and resinous.

Iron-flint is opaque, and slightly translucent on the edges. It is pretty hard, somewhat difficultly frangible, and approaching to heavy. It occurs in iron stone veins, and is found in Saxony, and, according to Larsten, at Bristol. It renders the iron ore, along with which it is dug, very difficult of fusion.

Twenty-second species. Quartz.

Werner divides this into five sub-species amethyst, rock chrystal, milk-quartz, common quartz, and prase. See QUARTZ, AMETHYST, &c.

Twenty-third species. Horn Stone.

Horn stone is divided into three sub-species, splintery horn-stone, conchoidal horn-stone, and wood-stone. See HORN-STONE.

Twenty-fourth species. Flint.

The general colour is grey, but with many varieties. It occurs massive, in regular plates in angular grains and species, in globular and elliptical rolled pieces, in the form of sand, and tuberose and perforated. Sometimes it is chrystallized, when it exhibits double six-sided prisms, or flat double three-sided pyramids. Internally, the lustre is glimmering translucent on the edges, hard, easily frangible, and not particularly heavy.

Twenty-fifth species. Chalcedony.

This is divided into two sub-species, chalcedony and carnelian, which see.

Agate.

The fossils known under this name are all compound substances; and hence cannot have a particular place in any systematic arrangement. Werner therefore has placed them as a supplement to the species chalcedony, which forms a principal constituent part of them. See AGATE.

Twenty-sixth species. Heliotrope.

Which see.

Twenty-seventh species. Plasma.

The usual colour is intermediate between grass and leek-green, and of different degrees of intensity. It occurs in indeterminably angular pieces, which have a rough earthy crust. Internally its lustre is glistening. It is intermediate between semitransparent and strongly translucent, hard, brittle, frangible without great difficulty, and not particularly heavy.

Twenty-eighth species. Chrysoprase.

Which see.

Twenty-ninth species. Flinty Slate.

This has been divided into two sub-species, common flinty slate, and Lydian stone.

Thirtieth species. Cat's Eye.

The principal colour is grey, of which it presents many varieties. It occurs in blunt-edged pieces, in rolled pieces, and likewise massive. Internally, it is shining; usually translucent, and sometimes also semitransparent. It is hard, easily frangible, and not particularly heavy.

Its geognostic situation is unknown. It is imported from Ceylon and the coast of Malabar; and is usually cut for ring-stones. Some of the varieties are highly valued.

Thirty-first species. Prehnite.

The colours are various shades of green, white, and yellow. It is sometimes massive and sometimes chrystallized in oblique four-sided tables. Externally, the chrystals are smooth and shining; internally, inclining to glistening and pearly.

Prehnite is translucent, sometimes passing into semi-transparent and transparent: it is hard, easily frangible, and not very heavy.

Thirty-second species. Zeolite.

This species is divided by Werner into five sub-species, 1. Mealy zeolite; 2. Fibrous zeolite; 3. Radiated zeolite; 4. Foliated zeolite; 5. Cubic zeolite.

All the different sub-species are natives of Scotland.

Thirty-third species. Cross Stone.

The colour is a greyish-white. It occurs chrystallized, either in broad rectangular four-sided prisms, or in twin chrystals. The chrystals are mostly small, and aggregated on one another. Both the internal and the external lustre is shining, inclining to splendent or glistening.

The cross-stone is translucent passing to transparent semi-hard, easily frangible, and not particularly heavy. It has hitherto been found only in mineral veins, and in agate-balls.

Thirty-fourth species. Agate Stone.

The colour is a perfect azure blue, of different shades. It is found massive, disseminated, and in rolled pieces. The lustre is glistening and glimmering. It is translucent on the edges, pretty hard, brittle, easily frangible, and not particularly heavy. See AGATE.

FOURTH GENUS.

CLAY *Genus.*

Species 1.—Jasper
Species 2.—Opal.
Species 3.—Pitch Stone.
Species 4.—Obsidian.
Species 5.—Pearl Stone.
Species 6.—Pumice Stone.

Seventh species. Felspar.

Is divided into four sub-species; compact felspar, common felspar, adularia, and Labradore stone. Fig. 15.

Eighth species. Pure Clay.

Is snow white, with occasionally a yellowish tinge, and occurs in kidney-shaped pieces, which have no lustre.

Ninth species. Porcelain Earth.

The colour is generally a reddish-white, of various degrees of intensity. It occurs massive and disseminated; its particles are fine and dusty, slightly cohering, and feeling fine and light.

Tenth species. Common Clay.

This is divided into six sub-species, as follows.

1. Loam. 2. Potters' clay is of two kinds, earthy and slaty. 3. Pipeclay. 4. Variegated clay, commonly white red and yellow; striped, veined, and spotted. It occurs massive, is passing into friable, feels a little greasy, and adheres somewhat to the tongue. 5. Clay stone, commonly grey or red, with various intermediate tints. 6. Slate clay.

Species 11.—Polier, or polishing Stone.
Species 12.—Tripoli.
Species 13.—Alum Stone.
Species 14.—Alum Earth.
Species 15.—Alum Slate.
Species 16.—Bituminous Shale.

Seventeenth species. Drawing Slate, or Black Chalk.

Its colour is a greyish-black, with a tinge of blue; it occurs massive, is opaque, colours and writes, is soft, mild, easily frangible, feels meagre but fine, and is rather light.

It is found in primitive mountains in France, Germany, Iceland, Scotland, and the Hebrides. When of a middling degree of hardness, it is used for drawing.

Eighteenth species. Whet Slate.

The common colour is greenish-grey, it is massive; internally, weakly glimmering, semi-hard, feels rather greasy, and it is not particularly brittle or heavy.

Nineteenth species. Clay Slate.

Its principal colour is grey, of which there are many varieties. It occurs massive; internally, its colour is glistening, the substance opaque, soft, and easily frangible. When spilt into thin and firm tables, it is used for roofing houses, and other purposes.

Twentieth species. Lepidolite.

Its colour is a kind of peach-blossom, red, verging on lilac-blue, and occurs massive. Its internal lustre is glistening; it is translucent, soft, easily frangible, and easily melts before the blowpipe. Hitherto it has only been found in Moravia, where it lies in gneiss. See MICA

Twenty-first species. Mica, or Glimmer.

Its common colour is grey, of great variety of shades.

Twenty-second species. Pot Stone.

Its colour is a greenish-grey, of different degrees of intensity; is massive; lustre, internally, glistening and pearly, translucent on the edges; soft, feels greasy, and is very difficultly frangible.

Twenty-third species. Chlorite,

Which see.

Twenty-fourth species. Horenblende,

Which see.

Twenty-fifth species. Basalt.

See BASALT.

Twenty-sixth species. Wacke.

The colour is a greenish-grey, of various degrees of intensity. It occurs massive and vesicular, is dull, somewhat glimmering, opaque, usually soft, more or less easily frangible, and not particularly heavy.

Twenty-seventh species. Clink Stone

Is commonly of a dark greenish-grey colour, always massive, and occurring in irregular columns, and tabular distinct concretions. It is usually translucent on the edges, brittle, easily frangible, and when struck with a hammer, sounds like a piece of metal.

It is said to belong to the floetz trap formation, and generally rests on basalt.

Twenty-eighth species. Lava.

Is divided into two sub-species.

1. Slag lava is a of greyish-black colour, passing into other shades.

2. Foam lava is of a dark greenish-grey colour, occurs small and fine, vesicular; externally, glimmering, slightly translucent on the edges, brittle, easily frangible, and light.

Twenty-ninth species. Green Earth.

Its colour is a celaden green, of various degrees of intensity. It occurs massive, in angular and globular pieces, and also disseminated. Internally, it is dull, streak glistening, very soft, easily frangible, and light.

It is principally found in amygdaloid, in Saxony, Bohemia, Scotland, and other places, and is used by painters.

Thirtieth species. Lithomage.

Is divided into two sub-species.

1. Friable lithomage, or rockmarrow, is snow-white, or yellowish-white, occurs massive, as a crust, and disseminated.

2. Indurated lithomage is most commonly white, of which it presents several varieties; is massive; internally, dull; streak shining.

Thirty-first species. Rock Soap.

Is of a brownish or pitch-black colour, massive and disseminated, dull, oqaque, does not soil, writes like drawing-slate, is easily frangible, and adheres strongly to the tongue.

Thirty-second species. Yellow Earth.

The colour is ochre-yellow, of different degrees of intensity.

To the clay genus, likewise, belong adhesive slate, float-stone, pinite, and umber.

FIFTH GENUS.
TALC *Genus.*

Species 1.—Bole.
Species 2.—Native Talc Earth.
Species 3.—Meerschaum.
Species 4.—Fuller's Earth.
Species 5.—Neaphrite.
Species 6.—Steatite.
Species 7.—Serpentine, which see.
Species 8.—Schiller-Stone.
Species 9.—Talc.
Species 10.—Asbest. See *Asbestos.*
Species 11.—Cyanite, which see.

Twelfth species. Actynolite.

Is divided into the following sub-species:

1. Asbestous actynolite is of a greenish-grey colour, occurs massive, disseminated, and in capillary chrystals; is internally glistening, translucent on the edges, soft, brittle, not easily frangible, nor particularly heavy. It is found in mineral beds in Saxony, and other parts of Germany.

2. Common actynolite is generally of a green leek-colour, passing into other shades of the same; it occurs massive, and likewise chrystallized in very oblique six-sided prisms, is splendent externally semi-hard, rather brittle, and not easily frangible.

It is found in beds in primitive mountains, in Saxony, Switzerland, Norway, and Scotland.

3. Glassy actynolite is principally of mountain-green colour, of various degrees of intensity.

SIXTH GENUS
CALC *Genus.*

First species. Rock Milk.

Its colour is yellowish-white; it is composed of dully, dusty particles, generally weakly cohering, feels meagre, soils very much, and is very light.

Second species. Chalk.

Its colour is principally all yellowish-white: it occurs massive, disseminated, and as crust over flint.

Third species. Lime-Stone.

Is divided into several sub-species:

1. Compact lime-stone is of two varieties, common compact lime-stone, and roe-stone. The former is generally of a grey colour, but is frequently veined, zoned, striped, or clouded.

2. Foliated limestone is likewise of two kinds, granular limestone, and calc spar.

3. Fibrous limestone, is of two varieties, common fibrous limestone, and fibrous limestone, or calc sinter.

4. Pea-stone is commonly yellowish-white, massive, internally dull, opaque or translucent on the edges; soft, very easily frangible

Species 4.—Schaum, or foaming earth.
Species 5.—Slate spar.
Species 6.—Brown spar.
Species 7.—Rhomb spar See *Spar.*
Species 8.—Schaalstone
Species 9.—Stink-stone.
Species 10.—Marle.

Eleventh species. Bituminous marle slate.

Its colour is intermediate between greyish and brownish-black; it is massive, from glimmering to shining, fragments slaty, usually soft, not very brittle, easily frangible, and streak shining. It is found in beds along with the oldest floetz limestone, and contains much copper intermixed with it, on account of which it is usually smelted in Thuringia.

Twelfth species. Calc tuff.

The colour is yellowish-grey; it is generally perforated or marked with the impressions of other substances, also amorphous, ramose, and corroded.

Thirteenth species. Arragonite.

The principal colours are greenish-grey, and iron-grey. It occurs chrystallized in perfect equiangular six-sided prisms; the lustre is glistening, passing into shining, and is vitreous; it is semihard, brittle, not particularly heavy, and phurphuresces a little. It was first discovered in the province of Arragon, whence its name, imbedded in gyps.

Fourteenth species. Appatite.

The usual colours are white, green, blue and red; it generally occurs chrystallized, the radical form of which is the equiangular six-sided prism. Externally it is splendent, internally shining and resinous. It is commonly transparent semihard, brittle, easily frangible, and occurs in tin veins, &c. in Saxony, Bohemia, and in Cornwall. It has been confounded with schorl, &c. See fig. 20.

Fifteenth species. Asparagus or spargel stone.

Sixteenth species. Boracite.

Its colours are yellowish, smoke, and greyish white, passing to asparagus green; it occurs in chrystallized cubes, with the edges and angles truncated, internally shining, commonly semitransparent, semihard, brittle, and easily frangible. Hitherto it has been discovered only at Luneburg in Hanover.

Seventeenth species. Fluor

Which see.

Eighteenth species. Gyps.

This is divided into the following sub-species:

1. Gyps earth is of a yellowish-white colour, passing into some allied shades, is intermediate between fine scaly and dusky, dull and feebly glimmering, soils a little, feels meagre but soft and fine, and is light. It is found, though rarely, in gyps countries.

2. Compact gyps, is commonly ash grey, passing into smoke and yellowish-grey, is massive, internally dull, feebly translucent on the edges, very soft, frangible without great difficulty, and is employed in architecture and sculpture, under the name of alabaster.

3. Foliated gyps is commonly white, grey, or red, presenting spotted, striped, and veined colour delineations.

4. Fibrous gyps is principally white, grey, and red, with various shades of each.

Gyps, when burnt, forms an excellent cement, and is used for many ornamental purposes.

Nineteenth species. Selenite

Its principal colour is snow-white, passing into other neighbouring shades.

Twentieth species. Cube Spar.

The colour is milk-white with various allied shades.

SEVENTH GENUS.

BARYTE *genus.*

First species. Witherite.

Is commonly of a light yellowish-grey colour, generally massive, but sometimes chrystallized in six sided prims, or double six-sided pyramids.

Second species. Heavy spar or baryte.

See BARYTES.

EIGHTH GENUS.

STRONTIAN *genus.*

First species. Strontian.

The usual colour is intermediate between asparagus and apple-green; it occurs most commonly massive, but sometimes chrystallized in a circular six-sided prism. The lustre of the principal fracture is shining, of the cross fracture glistening. It occurs along with lead-glance, heavy spar, &c. at Strontian in Argyleshire.

Second species. Celestine

Is divided into two sub-species:

1. Fibrous celestine, is of an intermediate colour, between indigo-blue and blueish-grey; it occurs massive and in plates, and also chrystallized, shewing a tendency to prismatic distinct concretions; is translucent, soft or semihard, easily frangible, and pretty heavy.

2. Foliated celestine, is of a milky-white colour, falling into blue; it occurs massive, and also chrystallized in six sided tables intersecting each other. It has a glistening lustre, is strongly translucent, softish, not particularly brittle, easily frangible, and hard. It occurs sometimes in sulphur beds, and is found very finely chrystallized in Sicily, and likewise near Bristol.

CLASS II.

FOSSIL SALTS.

The substances included in this class are confined to those which are found in a natural state only; and the greater part of them appear to be formed by the agency of water, air, &c. The distinguishing characters of fossil salts are, their taste and easy solution. They resemble each other so closely, that the term *saline consistence* is used to express whatever relates to hardness, tenacity, and frangibility.

Species 1.—Natron, or natural soda.
Species 2.—Natural nitre,
Species 3.—Natural rock-salt.
Species 4.—Natural sal-ammoniac.
Species 5.—Natural Epsom salt.
Species 6.—Natural Glauber salt.
Species 7.—Natural alum.
Species 8.—Hair salt.

Ninth species. Rock Butter.

The colour is light-yellow or greyish-white. It occurs massive and tuberose, is translucent, has a saline consistence, or sweetish-sour astringent taste, and feels a little greasy. It oozes out of fissures of rocks of alum slate, and is found in Lusatia, Thuringia, Denmark, Siberia, and near Paisley in Scotland.

Tenth species. Natural Vitriol

Is divided into the three following sub-species, viz. iron, copper, and zinc vitriol.

Here it must be remarked, that borax, though so well known by name, is without a place in the Wernerian system, as it is uncertain whether or not it occurs in a solid state. It is most probable that it occurs only in solution in certain lakes. See BORAX.

The new genus stallite, of which only one species, cryolite, has been found in Greenland, seems properly to come under this head.

CLASS III.

INFLAMMABLE FOSSILS.

Fossils belonging to this class are light, brittle, mostly opaque, yellow, brown, or black, seldom chrystallized, and never feels cold. They are more nearly allied to the metallic than to the earthy or saline classes.

FIRST GENUS.

SULPHUR *genus.*

First species. Natural sulphur.

It contains the two following sub-species:

1. Common natural sulphur, is of the colour the name expresses, but of different degrees of intensity.

2. Volcanic natural sulphur is of the colour the name imports, but with a considerable tinge of green.

SECOND GENUS.

BITUMINOUS *genus.* See BITUMENS.

First Species. Brown Coal. See COAL.

THIRD GENUS.

GRAPHITE *genus.*

First species. Glance Coal.

This is divided into two sub-species:

1. Conchoidal glance coal is of an iron-black colour, of different degrees of intensity, occurs massive and vesicular, internally shining, bordering sometimes on semihard, brittle, easily frangible, and light.

2. Slaty glance coal is of a dark iron-black colour, occurs massive, is shining and glistening, soft, very easily frangible, light, and intermediate between sectile and brittle.

Second species. Graphite.

This contains two sub-species:

1. Scaly graphite is commonly of a dark steel-grey colour.

2. Compact graphite is rather blacker than the preceding, is internally glimmering with a metallic lustre.

Third species. Mineral charcoal.

The colour is a greyish-black. It occurs in small angular and somewhat cubical-shaped pieces, is glimmering, with a silky lustre, soils strongly, is soft, and light. It is found in thin layers in different kinds of coal, and is widely disseminated.

FIFTH GENUS.

RESIN *genus.* See RESINS.

First species. Amber.

This is divided into the two following sub-species:

1. White amber is of a straw-yellowish colour. It occurs massive, and sometimes associated with the following sub-species.

2. Yellow amber is of a wax-yellow colour, passing into several neighbouring shades. It admits of a fine polish, and is cut into necklaces, bracelets, snuff-boxes, and various other articles.

Second species. Honeystone.

See MELLITE.

CLASS IV.

METALLIC FOSSILS.

FIRST, PLATINA *Genus.*

First species. Native platina.

The colour is very light steel-grey, approaching to silver-white. See PLATINA.

SECOND GENUS. *Gold.*

First species. Native gold.

This is divided into two sub-species:

1. Gold yellow native gold is of a perfect colour, corresponding to its name.

2. Brass-yellow native gold is principally of the colour of brass, occurs disseminated, capillary, moss-like, reticulated, and in leaves, also chrystallized in thin six-sided cubes, and is rather lighter than the preceding.

3. Greyish-yellow native gold is of a brass-yellow colour falling into steel-grey, occurs in very small flattish grains like platina.

THIRD GENUS. *Mercury,* which see.

Species 1.—Native mercury, or quicksilver.
Species 2.—Natural amalgam.
Species 3.—Mercurial horn-ore, or corneous mercury.
Species 4.—Mercurial liver-ore, or mercurial hepaticore.
Species 5.—Cinnabar.

FOURTH GENUS. *Silver.*

First species. Native silver.

Common native silver is of the colour the name expresses. It occurs massive, disseminated, in pieces, plates, and membranes, as well as in other forms. It is soft, perfectly malleable, common flexible, and very heavy when pure. See CHEMISTRY.

Species 2.—Antimonial silver.
Species 3.—Arsenical silver.
Species 4.—Corneous silver-ore, or horn-ore.
Species 5.—Silver-black.
Species 6.—Silver-glance.
Species 7.—Brittle silver-glance.
Species 8.—Red silver-ore.
Species 9.—White silver-ore.
Species 10.—Black silver-ore.

FIFTH GENUS. *Copper,* which see.

First species. Native copper.

The colour is copper-red, but frequently tarnished.

Second species. Copper glance.

Compact copper-glance is usually of a dark lead-colour, passing into blackish-grey.

Third species. Variegated copper-ore.

Its colour, when dug, is intermediate between copper-red and pinchbeck-brown, but it soon becomes tarnished. It occurs massive, disseminated in plates, membranes, and chrystallized in octahedrons.

Species 4.—Copper pyrites.
Species 5.—White copper-ore.

Sixth species. Grey copper-ore, or Fahl ore.

The most common colour is steel grey: it occurs massive, disseminated, and also chrystallized in tetrahedrons, octahedrons, and garnet dodecahedrons.

Species 7.—Copper black.
Species 8.—Red copper ore.
Species 9.—Tile oar.
Species 10.—Copper azure.
Species 11.—Malachite.

Eleventh species. Malachite, which see.

Twelfth species. Copper-green.

The principal colour is verdigris-green, of different degrees of intensity.

Thirteenth species. Iron-shot copper-green.

Earthy iron-shot copper-green is usually of an olive-green colour: occurs massive, and disseminated.

Fourteenth species. Copper-emerald.

The colour is an emerald-green. It occurs in chrystallized six-sided prisms, which are externally and internally shining.

Fifteenth species. Copper-mica.

Is usually of an emerald-green colour: it occurs massive, disseminated, and occasionally chrystallized in very thin six-sided tables. It is soft, sectile, not very brittle, nor particularly heavy; and has hitherto been found only in veins in Cornwall, where it passes under the unscientific name of foliatic arseniate of copper.

Sixteenth species. Lenticular ore.

The colour is sky-blue, sometimes passing into verdigris green.

Seventeenth species. Oliven ore.

Foliated oliven ore is of a perfect olive-green: seldom occurs massive, usually in drusy crusts, and in small chrystals.

SIXTH GENUS. *Iron.*

First species. Native iron

Is of a light steel-grey colour, inclining to silver-white: it has hitherto been found only ramose; internally it is intermediate between glimmering and glistening, with a perfect metallic lustre, and a hackly fracture. It is between soft and semihard, perfectly malleable, common flexible, difficultly frangible, and uncommonly heavy. Hitherto it has been found

only in loose masses on the surface of the earth, and is a rare production.

Second species. Iron pyrites.

Common iron pyrites is usually of a perfect bronze-yellow colour: it occurs massive, disseminated, in membranes, and also chrystallized in cubes, octahedrons, dodecahedrons, icosahedrons, and leuzite chrystals.

Third species. Magnetic pyrites

Is of an intermediate colour between bronze-yellow and copper-red: it occurs massive and disseminated.

Fourth species. Magnetic iron stone.

Common magnetic iron-stone is of an iron-black colour: is massive, disseminated, and also chrystallized in cubes, octahedrons, and garnet dodecahedrons, and rectangular four-sided prisms. It is externally shining; internally between splendent and glistening, with a metallic lustre; is intermediate between hard and semihard, brittle, and heavy. It occurs most frequently in primitive mountains. When pure, it affords excellent bar iron.

Fifth species. Iron glance.

Common iron glance is usually of a dark steel grey colour, with several different shades. It commonly occurs massive and disseminated, and also chrystallized in flat, double, three-sided pyramids, and in double three-sided pyramids.

Sixth species. Red iron-stone.

Red iron froth. The colour is intermediate between cherry-red and brownish-red. It occurs commonly friable, massive, sometimes coating and disseminated, and is composed of sealy particles, which are glimmering, and have a semi-metallic lustre.

Seventh species. Brown iron-stone.

Brown iron froth is of an intermediate colour between steel-grey and clove-brown, and is between friable and solid. It occurs massive, coating, spumous, &c. and is composed of scaly particles, shining and glistening, with a metallic lustre. It soils strongly, feels greasy, and is very light.

Eighth species. Sparry iron-stone.

The principal colour is a light yellowish grey, which, on exposure to the hair or heat, changes into brown or black. It occurs massive, disseminated, with pyramidal impressions, in plates, and chrystallized. It is chiefly confined to the primitive and floetz mountains.

Ninth species. Black iron-stone.

Compact black iron-stone, is of an intermediate colour between bluish-black, and dark steel grey.

Tenth species. Clay iron-stone.

Reddle is of a light brownish-red, passing into cherry-red: it occurs only massive; soils strongly, and writes, is sectile, easily frangible, and rather heavy. It is chiefly found in the newer clay-slate, and is produced pretty abundantly in Germany and Siberia. The coarser varieties are used by the carpenter, the finer by the painter, under the name of red chalk

Eleventh species. Bog iron-ore.

Morass ore is of a yellow-brown colour, sometimes friable, sometimes coherent, and occurs massive.

Twelfth species. Blue iron-earth.

When fresh it is whitish, but soon becomes of an indigo-blue colour, of different degrees of intensity.

Thirteenth species. Green iron-earth.

Friable green iron-earth is of a siskin-green colour, occurs massive and disseminated, is more or less cohering, soft, fine, easily frangible, and intermediate between particularly heavy and heavy.

Fourteenth species. Cube ore.

The colour is olive-green, of different degrees of intensity; it occurs massive, and chrystallized in small cubes.

SEVENTH GENUS. *Lead.*

First species. Lead glance.

Common lead glance is of a fresh lead-grey colour, of different degrees of intensity; it occurs massive, disseminated, in membranes, &c. and also chrystallized in cubes, octahedrons, four-sided prisms, six-sided prisms, and three-sided tables. It is soft, sectile, externally easily frangible, and uncommonly heavy; and is found in veins and beds in primitive, transitive, and floetz mountains. It is most frequently worked as an ore of lead, but sometimes as an ore of silver.

Species 2.—Blue-lead ore.
Species 3.—Brown-lead ore.
Species 4.—Black-lead ore.
Species 5.—White-lead ore.
Species 6.—Green-lead ore.
Species 7.—Red-lead ore.
Species 8.—Yellow-red ore.

Ninth species. Lead vitriol, or vitriol of lead.

The colour is yellowish-grey and greyish-white; it occurs only chrystallized in octahedrons of different figures.

Tenth species. Lead earth

Coherent lead earth is usually of a yellowish-grey colour; it occurs massive, is internally glimmering, and usually opaque.

EIGHTH GENUS. *Tin.*

First species. Tin pyrites.

The colour is intermediate between steel-grey and brass-yellow; it occurs massive and disseminated.

Second species. Tin stone.

The most common colour is blackish-brown.

Third species. Cornish tin ore, or wood tin.

The most usual colour is hair-brown, of different degrees of intensity; it occurs usually in rolled pieces.

NINTH GENUS. *Bismuth.*

First species. Native bismuth.

Its colour is silver-white, with an incli-

nation to red; it occurs massive disseminated in leaves, reticulated, and chrystallized in small four-sided tables.

Second species. Bismuth glance.

The colour is a light lead-grey; it occurs massive, disseminated, and in acicular and capillary chrystals.

Third species. Bismuth-ochre.

The colour is a straw-yellow, passing into other neighbouring shades.

TENTH GENUS. *Zinc.*

First species. Blende.

Yellow blende is of a dark wax and sulphur yellow colour; it usually occurs massive and disseminated.

Second species. Calamine.

The general colour is yellowish-grey, which passes into other neighbouring shades; it occurs massive, disseminated, cellular, corroded, &c.

ELEVENTH GENUS. *Antimony.*

First species. Native antimony.

The colour is perfect tin-white; it occurs massive disseminated, reniform, and probably chrystallized.

Species 2.—Grey.
Species 3.—Black.
Species 4.—Red.
Species 5.—White antimony ore.
Species 6.—Antimony-ochre.

TWELFTH GENUS. *Cobalt.*

First species. White cobalt ore.

When fresh fractured the colour is usually tin-white; it occurs massive, disseminated &c.

Second species. Grey cobalt ore.

On the fresh fracture its colour is light steel grey, inclining to white, but it becomes tarnished by exposure.

Third species. Cobalt glance.

The colour is a silver white, slightly inclining to reddish: it is commonly massive and disseminated, sometimes chrystallized in different forms; is externally splendent, internally between shining and glistening, and has a metallic lustre. It is semihard, brittle, not very easily frangible; and when struck with steel, emits an arsenical smell. It is found in veins in various formations, in the different mine countries of the continent of Europe; and from it the greatest part of the cobalt in commerce is obtained, which is highly useful in the manufacture of glass, and as a pigment.

Fourth species. Black cobalt ore.

Earthy black cobalt ore is of an intermediate colour between brownish and bluish-black.

Fifth species. Brown cobalt ochre

Is of a liver-brown colour, passing sometimes into other neighbouring shades; it occurs massive and disseminated.

Sixth species. Yellow cobalt ochre.

Is usually of a dirty straw-yellow, occurs massive, frequently much corroded.

Seventh species Red cobalt ochre.

Cobalt crust is of a peach blossom-red colour.

THIRTEENTH GENUS. *Nickel.*

First species Copper nickel.

Is of a red copper-colour of different degrees of intensity.

Second species. Nickel ochre

Is of an apple-green colour, occurs always as a coating or efflorescence.

FOURTEENTH GENUS. *Manganese.*

First species. Grey manganese ore.

Radiated grey manganese ore is of a dark steel grey colour, occurs massive, disseminated, and chrystallized in prisms of different varieties.

Second species. Black manganese ore.

Is of an intermediate colour between brownish-black and dark-greyish black, occurs massive, disseminated, and in octahedral chrystals.

Third species. Red manganese ore

Is of a light rose-red colour, occurs massive and disseminated.

FIFTEENTH GENUS. *Molybdena.*

First species. Molybdena.

Its colour is a fresh burning lead-grey; it occurs usually massive and disseminated, but also chrystallized in six-sided tables, and short six-sided prisms.

SIXTEENTH GENUS. *Arsenic.*

First species. Native arsenic.

When fresh broken it is of a light whitish lead-grey colour, but it speedily tarnishes; it occurs massive, disseminated, reniform, and in plates, with various impressions.

Second species. Arsenic pyrites.

Common arsenic pyrites is, when fresh, of a silver-white colour, but soon acquires a yellowish tarnish.

Third species. Orpiment

Red orpiment is of an aurora-colour, of different degrees of intensity: it occurs massive, disseminated in membranes.

Fourth species. Arsenic bloom.

The colour is of a reddish-white and snow-white; it occurs as a coating, in small balls, &c.

SEVENTEENTH GENUS. *Scheele.*

First species Tungsten.

The colour is usually yellowish and greyish-white, which pass into several other neighbouring shades.

Second species. Wolfram

Is of an intermediate colour between dark greyish-black and brownish-black; it occurs massive, and also chrystallized in broad six-sided prisms; and rectangular four-sided tables.

EIGHTEENTH GENUS. *Menachine.*

First species. Menachanit.

Is of a greyish-black colour, inclining to iron-black, occurs only in small flattish angular grains.

Second species. Octrahedrite.

Its colour passes from indigo-blue to many other shades; it occurs only chrystallized.

Third species. Rutile

Is of a dark blood-red colour, of various degrees of intensity; it occurs always chrystallized in four-sided and six-sided prisms.

Fourth species. Nigrine

Is of a dark brownish-black colour, passing to velvet-black; it occurs in larger and smaller angular grains, and in rolled pieces.

Fifth species. Iserine.

Is of an iron-black colour, somewhat inclining to brownish black; it occurs usually in small obtuse angular grains, and in rolled pieces, internally glistening, with a semi-metallic lustre, is completety opaque, hard, brittle, and retains its colour in the streak.

NINETEENTH GENUS. *Uran.*

First species. Pitch ore

Is usually of a velvet-black colour; it occurs almost always massive and disseminated.

Second species. Uran mica.

The principal colour is a grass-green, passing into various allied shades; it occurs sometimes in membranes, but commonly chrystallized in rectangular four-sided tables.

Third species. Uran Ochre.

Friable uran ochre is usually of a straw-yellow colour; it generally occurs as coating or efflorescence on pitch ore.

TWENTIETH GENUS. *Sylvan.*

First species. Native Sylvan.

Is of an intermediate colour between white and silver-white: occurs massive, and disseminated, and also chrystallized.

Second species. Graphic ore.

Its colour is a light steel-grey: it occurs massive and chrystallized; externally is splendent, internally glistening.

Third species. Yellow Sylvan ore

Is of a silver-white colour, inclining to brass-yellow; it occurs disseminated, and chrystallized in very small, and rather broad four-sided prisms.

Fourth species. Black Sylvan

Is of an intermediate colour between iron-black, and blackish lead-grey; it occurs massive, and in small, thin, and longish six-sided tables.

TWENTY-FIRST GENUS. *Chromium.*

First species. Acicular, or Needle ore.

Its colour is dark-steel-grey: occurs in imbedded acicular chrystals: internally shines with a metallic lustre, is soft, not very brittle, heavy, and is always accompanied with chrone, ochre, and sometimes with native gold. It is found in Siberia.

Second species. Chrome ochre.

Is of a verdigris-green, passing through several neighbouring shades; it occurs massive disseminated, and in membranes; is dull, soft, not very heavy, and is found with the preceding species

Explanation of the Plates.

PLATE XXXV.

FIG. 1. The Icosahedron.
2. The Dodecahedron.
The Hexahedron, as
3. Cube.
4. Rhomb.
5. Rectangular tetrahedral prism.
6. Oblique-angular tetrahedral prism.
7. Oblique-angular tetrahedral prism, in which the terminal planes are set obliquely on the lateral planes.
8. Equiangular hexahedral prism.
9. Tetrahedron, or simple three-sided pyramid.
10. Double three-sided pyramid, in which the lateral planes of the one pyramid are set on the lateral edges of the other.
11. Octahedron.
12. Simple six-sided pyramid.
13. Double six-sided pyramid, in which the lateral planes of the one pyramid are set on the lateral planes of the other.
14. Double six-sided pyramid, in which the planes of the one pyramid are set obliquely on those of the other, so that the common base forms a zig-zag line.
15. Rectangular four-sided table.
16. Oblique-angular four-sided table.
17. Equiangular six-sided table.
18. Lengthened six-sided table.
19. and 20. Common lens.

Alterations of the Fundamental Figures by Truncation.

21. Cube truncated on all its angles.

PLATE XXXVI.

22. Cube truncated on all its edges.

By Bevelment.

23. The cube bevelled on all its edges.
24. Three-sided prism having its lateral edges bevelled.
25. Oblique-angular four-sided prism bevelled on its extremities.
26. Six-sided table, with bevelled terminal planes.
27. Octahedron, with bevelled angles.

By Acumination.

28. Cube, with the angles acuminated by three planes which are set on the lateral plan.
29. Cube, with the angles acuminated by three planes which are set on the lateral edges.
30. Rectangular four-sided prism acuminated by four planes, which are set on the lateral planes.
31. Equiangular six-sided prism, acuminated on both extremities by six planes, which are set on the lateral planes.

32. Four-sided prism acuminated on both extremities by four planes, which are set on the lateral edges.
33. Six-sided prism, acuminated on both extremities by three planes, which are set on the alternate lateral planes.
34. Six-sided prism, acuminated on both extremities by three planes, which are set on the alternate lateral edges.
35. Double eight-sided pyramids, acuminated on both extremities by four planes, which are set on the alternate lateral edges.

MINIATURE, a delicate kind of painting, distinguished by the smallness of the figures, its being performed with dots or points, instead of lines; by the faintness of the colouring; its requiring to be viewed very near; and by its being usually done on ivory.

MINIMUM, in the higher geometry, the least quantity attainable in a given case. See MAXIMUM.

MINISTER, a person who preaches, performs religious worship in public, administers the sacraments, &c.

MINISTER, *of state*, a person to whom a sovereign prince intrusts the administration of the government.

MINISTER, *foreign*, is a person sent into a foreign country to manage the affairs of his province, or of the state to which he belongs. Of these there are two kinds: those of the first rank are embassadors and envoys extraordinary, who represent the persons of their sovereigns. The ministers of the second rank are the ordinary residents.

MINOR, in law, is an heir, either male or female, before they arrive at the age of twenty-one; during the minority of such, they are usually incapable of acting for themselves.

MINOR, in logic, the second proposition of a regular syllogism.

MINSTREL, in ancient customs, certain persons who combined the character of poet and musician, and whose profession it was to wander about the countries they inhabited, singing panegyrical songs and verses on their occasional benefactors, accompanying them with some musical instrument.

MINT, the place in which the king's money is coined. See COINING.

MINUTE, in geometry, the sixtieth part of degree of a circle.

Minutes are denoted by one acute accent, thus ('); as the second, or sixtieth part of a minute, is by two such accents, thus (".); and the third by three ('''), &c.

MINUTE of time, the sixtieth part of an hour.

MIRACLE, is defined by Dr. Samuel Clark to be a work effected in a manner different from the common and regular method of Providence, by the interposition either of God himself, or some intelligent agent superior to man. The writer, now cited, maintains, that miracles are neither the effects of natural causes, nor of superior created intelligences acting from themselves alone; but that they are always to be ascribed to a divine interposition; *i. e.* that they are never wrought, but either immediately by God himself, or by such other beings as he commissions and empowers to perform them. In proof of this proposition he alleges, that the same arguments which prove the existence of superior created intelligences, do much more strongly conclude against their acting out of their proper sphere. Further, the supposition of the power, of any created agents to work miracles of themselves in this lower world, is contradicted by the observation and experience of all ages; there being, in fact, no proper evidence of the truth of any miracles, but such as may be fitly ascribed to the Deity. The stress usually laid on what is termed the evidence of miracles in favour of the Christian system is certainly too great. The effect of such interpositions is evidently compulsory, not persuasive. This is manifest from their whole history; and particularly so from that part of it which describes their commencement. An ignorant and idolatrous people were at once, as it were, forced into an assembly representative of the true church of God; and a constant succession of miracles was necessary to keep them in this state. This was a very different thing from persuasion; indeed, miracles are expressly said to be "for those who believe not." And, indeed, down to the latest period of their being wrought we find them so generally productive of a hardening and irritating effort on the minds of those who witnessed them, that, on one occasion, at least, *He*, who hath the controul of the universe, is said to have seen it to be necessary to abstain from doing mighty works among the people "*because of their unbelief.*" Nor is this to be wondered at when we consider that the grand end of miracles from first to last, was to shadow forth the nature of the great work of human redemption, effected by Omnipotence, and its application to the regeneration, and consequent salvation of man; for to every exhibition of this wonderful plan of mercy, the human mind has always manifested its aversion.

MIRROR. See OPTICS.

MISCHIEF. Malicious mischief is an injury of such a gross nature, to personal property, that although it is not done with a felonious intention, or an intent to steal, the law has inflicted punishment upon it by various statutes. By statute 6, George I. c. 23, the wilfully and maliciously tearing, cutting, spoiling, or defacing, the garments of any person passing in the streets or highways, and assaulting, with intent to do so, is felony. And there are other acts which relate to the prevention of setting fire to out-houses with corn, damaging fish-ponds, trees planted in gardens, cutting down sea-banks, hop binds, setting fire to mines preventing persons from buying corn, setting fire to goss, furze, &c.; wilfully burning engines in mines, fences in enclosures, breaking into houses of the Plate Glass Company, with intent to destroy utensils; breaking into houses to cut or destroy cloth, serge, linen, &c. in the loom, and other similar offences.

MISCHNAH, or MISNAH, the code or collection of the civil law of the Jews. The Jews pretend that when God gave the written law to Moses, he gave him also another not written, which was preserved by tradition among the doctors of the synagogue, till Rabbi Judah, surnamed the Holy, seeing the danger they were in, through their dispersion, of departing from the traditions of their fathers, judged it proper to reduce them to writing. The Misnah

is divided into six parts: the first relates to the distinction of seeds in a field, to trees, fruits, tythes, &c.; The second regulates the manner of observing festivals; the third treats of women, and matrimonial cases; the fourth of losses in trade, &c. the fifth is on obligations, sacrifices, &c.: and the sixth treats of the several sorts of purification.

MISDEMEANOUR. A crime or misdemeanour is an act committed or omitted, in violation of a public law, either forbidding or commanding it.

MISLETOE. See Viscum.

MISNOMER, the using of one name for another. Where a person is described so that he may not be certainly distinguished and known from other persons, the omission, or in some cases the mistake of the name shall not avoid the grant. But in actions and indictments, &c. the misnomer may be pleaded, and will abate the suit or indictment.

MISPRISION, is generally understood to be of all such high offences as are under the degree of capital, but bordering thereon, and it is said that a misprision is contained in every treason and felony whatsoever; and that if the king please, the offender may be proceeded against for the misprision only.

MISSIONARIES, are those persons who are sent by any Christian church into Pagan or infidel countries, for the purpose of teaching the natives the Christian religion.

The following is a list of the leading institutions among the Protestant churches which have sent out and supported missions among the heathen. The Corporation for the propagation of the gospel in New England, and the adjacent parts of America, erected in 1649. Of this Society the Hon. Mr. Boyle was Governor about 3 years.

The Society in London for promoting Christian knowledge, instituted 1698.

The Society for the Propagation of the Gospel in Foreign Parts, incorporated 1701.

The Society in Scotland for propagating Christian knowledge, incorporated 1709.

The Royal Danish Mission College.

The Moravians, or United Brethren, 1732.

The Methodist Missionary Society, 1786.

The Baptist Missionary Society, instituted 1792.

The London Missionary Society, instituted 1795.

The Edinburgh (now the Scottish) Missionary Society, instituted 1796.

The Church of England Missionary Society instituted 1799.

The American Board of Commissioners for Foreign Missions, instituted 1810.

The Baptist American Board of Commissioners for Foreign Missions, instituted 1814.

MISSIVE, something sent to another, as missive letters; meaning letters sent from one to another upon business, in contra-distinction to letters of gallantry, points of learning, dispatches, &c.

MITCHELLA, in botany, so named from John Mitchell, M. D. a physician, in Virginia, a genus of the tetrandria monogynia class and order. The cor. is 1-petalled; stigmas 4; berry trifid, 2-seeded. There is one species, an herb of N. America.

MITE, a small coin formerly current, equal to about one third part of a farthing. It also denotes a small weight used by the moneyers. It is equal to the twentieth part of a grain, and is divided into twenty-four doits.

Mite. See Acarus.

MITRE, a sacerdotal ornament worn on the head by bishops, and certain abbots, on solemn occasions; being a sort of cap, pointed, and cleft at top. The high priest among the Jews wore a mitre or bonnet on his head. The inferior priests among the Jews had likewise their mitres, but in what respect they differed from that of the high priest is uncertain. Some contend that the ancient bishops wore mitres, but this is by no means certain. Those young women among the primitive Christians who professed a state of virginity, and were solemnly consecrated thereto, wore a purple and golden mitre as a badge of distinction.

MITTIMUS, a writ by which records are transferred from one court to another. This word is also used for the precept directed to a gaoler, under the hand and seal of a justice of the peace, for the receiving and safe keeping a felon, or other offender, by him committed to gaol.

MIZEN, in the sea-language, is a particular mast or sail. The mizen-mast stands in the sternmost part of the ship. Its length is by some accounted the same with the height of the main-top-mast, from the quarter-deck; or half the length of the main-mast, and half as thick. The sail which belongs to the mizen-mast, is called the mizen-sail: and when the word mizen is used at sea, it always means the sail.

MINIUM, in botany, a genus of the cryptogamia musci class and order. Nat. order of mosses: capsule with a lid; calyptre smooth; bristle from a terminating tubercle: male flowers headed, or discoid. M. *hygrometricum* is the most remarkable species. If the fruit-stalk be moistened at the bottom, the head makes three or four turns; and if the head be moistened, it turns the contrary way.

MOAT, or Ditch, in fortification, a deep trench dug round the rampart of a fortified place. The brink next the rampart is called the scarp; and the opposite one, the counterscarp. A dry moat round a large place, with a strong garrison, is preferable to one full of water, because the passage may be disputed inch by inch. In the middle of dry moats, there is sometimes another small one, called a cunette; which is generally dug so deep, till they find water to fill it.

MODE, in logic, called also syllogistic mood, a proper disposition of the several propositions of a syllogism, in respect of quantity and quality.

Mode, in philosophy, denotes the manner of a thing's existence.

Mode, in music, a particular manner of constituting the octave; or, the melodious constitution of the octave, as it consists of seven essential sounds, besides the key of fundamental.

MODEL, in a general sense, an original pattern, proposed for any one to copy or imitate. This word is particularly used in building, for an artificial pattern made in wood, stone, plaster, or other matter, with all its parts and proportions, in order for the better conducting and executing some great work, and to give an idea of the effect it will have

They also use models in painting and sculpture; whence, in the academies, they give the term model to a naked man or woman, disposed in several postures, to afford an opportunity to the scholars to design him in various views and attitudes. Models in imitation of any natural or artificial substance, are most usually made by means of moulds composed of plaster of Paris. When a model is to be taken, the surface of the original is first to be greased, in order to prevent the plaster from sticking to it. The original is then to be laid on a smooth table, previously greased, or covered with a cloth, to prevent the plaster sticking to it; then surround the original with a frame or ridge of glazier's putty, at such a distance from it as will admit the plaster to rest upon the table, on all sides of the subject for about an inch, or as much as is sufficient to give the proper degree of strength to the mould. A sufficient quantity of plaster is then to be poured as uniformly as possible over the whole substance, until it is every where covered to such a thickness as to give a proper substance to the mould, which may vary in proportion to the size. The whole must then be suffered to remain in this condition till the plaster has attained its hardness. When the frame is taken away, the mould may be inverted, and the subject removed from it; and when the plaster is thoroughly dry, let it be well seasoned.

MODILLIONS, in architecture, ornaments in the corniche of the Ionic, Corinthian, and Composite columns. They are little inverted consoles, or brackets, in form of an S, under the soffit of the corniche, seeming to support the projecture of the larmier, though in reality they are no more than ornaments.

MODULATION, in music, the art of conducting harmony, in composition, or extemporary performance, through those keys and modes which have a due relation to the fundamental, or original key.

MODULE. See Architecture.

MODUS DECIMANDI, in law, is where money, land, or other valuable consideration, has been given, time out of mind, to the minister or parson of any certain place, in the room of tithes.

MOERHINGIA, mossy chickweed, in botany, a genus of the octandria digynia class of plants, the flower of which is composed of four short, undivided petals; and its fruit is a subglobose capsule, with one cell, in which are contained numerous roundish seeds. There is one species.

MOHAIR, in commerce, the hair of a kind of goat, frequent about Angora, in Turkey; the inhabitants of which city are all employed in the manufacture of camblets, made of this hair.

MOISTURE, a term sometimes used to denote animal fluids, the juices of plants, or dampness of the air, or other bodies.

MOLE. See Talpa.

MOLE-CRICKET. See Gryllus.

MOLLUGO, in botany, a genus of the triandria trigynia class and order. Nat. ord. caryophyllei. Calyx, five-leaved; corolla, none; capsule, three-celled, three-valved. There are six species, annuals of warm countries.

MOLLUSCA, in natural history, the second order of the Linnæan class vermes. They are naked; furnished with tentacula, or arms; for the most part inhabitants of the sea; and by their phosphoreous quality, illuminate the dark abyss of the waters. This order, comprised of simple animals furnished with limbs, is distinguished in the following way: A, mouth placed above; B, mouth placed before; C, mouth placed before; body with a lateral perforation; D, mouth before: body surrounded with feelers on the fore part; E, mouth before, body furnished with arms; F, mouth before: body furnished with peduncles or feet; G, mouth placed beneath, and generally central.

MOLOSSES, in commerce, the thick fluid matter remaining after the sugar is made, resembling syrup. See Sugar.

MOLTING, the change of feathers, hairs, or horns, in birds and beasts.

MOLYBDATES, in chemistry, salts formed from the molybdic acid and the earths, alkalies, &c. They are mostly colourless, and soluble in water; they have a metallic taste. The prussiate of potash throws down from several of them a light brown coloured precipitate.

MOLYBDENUM. A metal which has not yet been reduced into masses of any magnitude; but has been obtained only in small separate globules, in a blackish brilliant mass. This may be effected by making its acid into a paste with oil, bedding it in charcoal in a crucible, and exposing it to an intense heat. The globules are grey, brittle, and extremely infusible. By heat it is converted into a white oxide, which rises in brilliant needle-formed flowers, like those of antimony. Nitric acid readily oxidizes and acidifies the metal. Nitre detonates with it, and the remaining alkali combines with its oxide.

Molybdenum unites with several of the metals, and forms brittle or friable compounds. No acid acts on it but the nitric and nitromuriatic. Several acids act on its oxide, and afford blue solutions. See Acid (Molybdic.)

The sp. gr. of molybdenum is 8.611. When dry molybdate of ammonia is ignited in a crucible with charcoal powder, it is converted into the brown oxide of the metal. This has a crystallized appearance, a copper-brown colour, and a sp. gr. of 5.66. It does not form salts with acids. The deutoxide is molybdous acid, which see.

MOMENT, in the doctrine of infinites, denotes the same with infinitesimal.

Moment, *momentum*, in mechanics, signifies the same with impetus, or the quantity of motion in a moving body; which is always equal to the quantity of matter, multiplied into the velocity; or, which is the same thing, it may be considered as a rectangle under the quantity of matter and velocity.

MONADELPHIA, (from *μονος alone*, and *αδελφια* a *brotherhood;*) a "single brotherhood." The —— of the 16th class in Linnæus's sexual system, consisting of plants with hermaphrodite flowers; in which all the stamina, or male organs of generation, are united below into one body or cylinder, through which passes the pointal or female organ. See Botany.

MONANDRIA, (from *μονος alone*, and *ανηρ man* or *husband,)* the name of the first class in Linnæus's sexual system; consisting of plants with hermaphrodite flowers, which have only one stamen or male organ.

MONARCHY, a government in which the supreme power is invested in a single person. There are several kinds of monarchies, as where the monarch is invested with an absolute power, and is accountable to none but God. Another kind of monarchy is that which is limited, where the supreme power is virtually in the laws, though the majesty of government and the administration is vested in a single person. Monarchies are also either hereditary, where the regal power descends immediately from the possessor to the next heir by blood; or elective, where the choice depends upon all who enjoy the benefit of freedom, or upon a few persons in whom the constitution vests the power of election.

MONAS, a genus of vermes, order infusoria. The generic character is, worm invisible to the naked eye, most simple, pellucid, resembling a point. There are five species.

MONEY, a substance, commonly metal, and generally of a determined shape and weight, to which public authority has affixed a certain value to serve as a medium in commerce. Money is usually divided into real or effective; and imaginary, or money of account.

Real money includes all coins, whether of gold, silver, copper, or the like. Imaginary money, or money of account, is that which never existed, or at least, which does not exist in real specie; but is a denomination invented or retained to facilitate the stating of accounts, by keeping them still on a fixed footing, not to be changed like current coins.

No person is obliged to take in payment any money which is not lawful metal, that is, of silver and gold, except for sums under sixpence. But it was decided in 1790, that bank-notes were considered as money, and therefore a proper tender in payment.

English Money *of account*, is the pound, shilling, and pence; the pound contains twenty shillings, and the shilling twelve pence.

The old Scotch Money *of account* was the pound, shilling, and penny; the pound containing twenty shillings, being equivalent to one shilling and eightpence English; and the shilling containing twelve pennies, equal to a penny English. There is also among them an account of marks, the mark being equivalent to one shilling 1⅓ penny English: of this last kind they had formerly a silver coin.

Money *bringing into court*. In some actions at law the defendant is allowed to pay a sum into court, which he contends is the fair amount of the plaintiff's just demand, and the plaintiff will afterwards proceed at his peril. This can only be done where the damages can readily be ascertained in money.

MONKEY. See Simia.

MONOCHORD, a musical instrument, composed of one string, used to try the variety and proportion of sounds. It is formed of a rule, divided and sub-divided into several parts, on which there is a moveable string stretched upon two bridges at each extreme. In the middle between these is a moveable bridge, by means of which, in applying it to the different divisions of the line, the sounds are found to bear the same proportion to each other as the division of the line, cut by the bridge.

MONOCULUS, in natural history, a genus of insects of the order Aptera. Legs four to eight, formed for swimming, and very long; body covered with a crest, or shell, divided into segments; antennæ sometimes four, sometimes two, and sometimes without any; four feelers, in continual motion when swimming, the hind ones very small, and hook-shaped. There are about 50 species, separated into sections. A. With a single eye, and crustaceous body. B. With a single eye, and bivalve shell; antennæ branched. C. With a single eye, and bivalve shell; antennæ simple. D. With a single eye, and bivalve shell; antennæ tufted at the tip. E. With a single eye, and univalve shell; antennæ two. F. Shell univalve; two eyes placed beneath. G. Shell bivalve; eyes two, placed on the back. The greater part of the monoculi are very small water insects, requiring the assistance of the microscope for the investigation of their particular organs. To this there is, however, an exception in the M. *polyphemus*, which inhabits India. This is distinguished by the title of the Molucco crab, or king crab, and grows sometimes to the length of four feet. In this species the eyes, instead of being approximated, as is required in the Linnæan generic character, are extremely distant from each other, being situated towards the sides of the shell. "The whole structure of this animal is very remarkable and particularly his eyes, which are between the fourth and last pair of claws on each side, reckoning from his mouth, and excluding the small pair there placed, are inserted the rudiments of another pair, or a claw broken off on each side at the second joints or elbow; on these extremities are the eyes like those of the horns of snails; but under the covert of a thick and opaque shell nature in that place has wonderfully contrived a transparent lantern, through which the light is conveyed."

MONODON, the *narwhal*, in natural, history a genus of mammalia of the order cetæ. Generic character: tooth (sometimes two teeth) in the upper jaw, projecting straight forward, long and spiral; spiracle on the head. The only species of this genus is M. *monoceros*, or the unicorn narwhal; this is found in northern seas, and generally of the length of twenty feet from the mouth to the tail; from a socket in the upper jaw on one side, a tooth somewhat resembling a horn grows, in a perfectly straight direction, and a wreathed or screw-like form, to the length of six, and occasionally nine or ten feet, of a light yellow colour, and terminating in a sharp point, a circumstance by which it is discriminated from every other species of whales. The incipient protrusion of a second tooth on the other side of the jaw is generally perceivable, and in some instances, though rarely, both advance to maturity. The narwhals subsist principally upon flat fish. They are seldom observed in the open sea, and frequent the unfrozen spots near the coast of the arctic regions. They are taken by the Greenlanders in great abundance by the harpoon; their flesh is eaten prepared in various ways, and the oil and intestines are also articles in great request. The tendons are split into thin fibres, serving the purposes of thread, and the teeth are used sometimes for hunting horns, and more frequently as pillars and gate-posts in houses.

These horns were formerly considered as indicative of royal state and magnificence, being employed as the ornaments of palaces.

MONOECIA, from *μονος alone*, and *οικια a house*: the name of the 21st class of Linnæus's sexual method. See BOTANY.

MONOGRAM, a character or cypher, composed of one, two, or more letters, interwoven; being a kind of abbreviation of a name, anciently used as a seal, badge, arms, &c. The use of arms is very ancient, as appears from Plutarch, and from some Greek medals of the time of Philip of Macedon and Alexander his son. The Roman labarum bore the monogram of Jesus Christ, which consisted of two letters, a P placed perpendicularly through the middle of an X, as we find it on many medals in the time of Constantine, these being the two first letters of the word ΧΡΙΣΤΟΣ. Thus under the eastern empire it is usual to find MIK, which are the monogram of Mary, Jesus, Constantine.

MONOGYNIA from *μονος alone*, and *γυνη a woman*: the name of the first order or subdivision in the first 13 classes of Linnæus's sexual method; consisting of plants, which have only one style, or female organ.

MONOTONY, an uniformity of sound, or a fault in pronunciation, when a long series of words are delivered in one unvaried tone.

MONSOON, in physiology, a species of trade wind, in the East Indies, which for six months blows constantly the same way, and the contrary way the other six months. However, it ought to be observed, that the points of the compass from whence the monsoons blow, as well as the times of their shifting, differ in different parts of the Indian ocean. The cause of monsoons is this: when the sun approaches the northern tropic, there are countries, as Arabia, Persia, India, &c. which become hotter, and reflect more heat than the seas beyond the equator, which the sun has left; the winds therefore, instead of blowing from thence, to the parts under the equator, blow the contrary way; and, when the sun leaves those countries, and draws near the other tropic, the winds turn about, and blow on the opposite point of the compass.

MONTH, in chronology, the twelfth part of a year. An astronomical month is that which is governed either by the motion of the sun or moon, and is consequently of two kinds, solar and lunar: a solar month is that time in which the sun seems to run through a whole sign, or the twelfth part of the ecliptic. The real mean quantity of a solar month is 30 days, 10 hours, 29 minutes, 5 seconds. A lunar month is that space of time which the moon takes up in performing its course through the zodiac, or that measured by the motion of the moon round the earth; and is of 3 kinds, viz. periodical, synodical, and that of illumination. The lunar periodical month, is the space of time wherein the moon makes her round through the zodiac, or wherein she returns to the same point, being 27 days, 7 hours, 43 minutes, and 5 seconds. The lunar synodical month, called also absolutely the lunar month and lunation, is the space of time between two conjunctions of the moon with the sun; or the time it takes from one conjunction with the sun to the next; or from one new moon to another.

A civil or political month, consists of a certain number of days according to the laws and customs of the different countries wherein it is used, either having no regard to the solar or lunar months, as those of the Egyptians in their equal year; of the Romans in the year of Romulus, &c.; or coming pretty near to the solar astronomical month, as the Julian, or else the lunar astronomical as the Jewish, Turkish, and others.

Civil solar months, are such civil months as are accommodated to the astronomical months, or those which are to consist alternately of thirty and thirty-one days, excepting one month of the twelve, which, for every fourth year, consisted of thirty days, and for the other years of twenty-nine. This form of civil months was introduced by Julius Cæsar; but under Augustus the sixth month, till then, from its place, called Sextilis, was denominated Augustus, in honour of that prince; and to make the compliment yet the greater, a day was added to it, so that it now consists of thirty-one days, to make up for which a day was taken from February, so that from thenceforward it only consisted of twenty-eight days, and every fourth year of twenty-nine: though before it had ordinarily consisted of twenty-nine days, &c. and such are the civil or calender months which now obtain throughout Europe.

Civil lunar months are to consist alternately of twenty-nine and thirty days: thus will two civil months be equal to two astronomical ones, abating for the odd minutes, and consequently the new moon will be hereby kept to the first day of each such civil month, for a long time together. However, to make them keep constantly pace with the civil months, at the end of each nine hundred and forty-eight months, a month of twenty-nine days must be added; or else every thirty-third month must consist of thirty days. This was the month in civil or common use among the Jews, Greeks, and Romans, till the time of Julius Cæsar.

MONTIA, water chickweed, a genus of the trigynia order, in the triandria class of plants; and in the natural method ranking with those two of which the order is doubtful. There is one species.

MOOD, or *Mode*, in grammar, the different manner of conjugating verbs, serving to denote the different affections of the mind.

MOON. See ASTRONOMY.

MOONSTONE. This is the purest felspar hitherto found. It occurs in Ceylon and Switzerland; colour white; sometimes with a shade of yellow, green, or red.

MOORING, in the sea-language, is the laying out the anchors of a ship in a place where she can ride secure. Mooring across, is laying out on each side; and mooring along, is to have an anchor in a river and a hawser on shore.

MORAVIANS, HERRNHUTTERS, or UNITAS FRATRUM, in church history, a denomination of Christians, concerning whose origin, history, and character, various contradictory reports have been published. The church of the United Brethren is episcopal, and their church government is conducted with great form and regularity. Questions of dispute are settled by ballot, and in cases

of real or supposed importance are often decided by lot. The lot is deemed a solemn appeal to heaven, and is made use of with great seriousness. They have œconomies, or choir-houses, where they live together in community: the single men and single women apart, widows and widowers apart, each under the superintendance of elderly persons of their own class. The Moravians are very strict in their attention to the youth of both sexes, and never suffer them to come together or to marry without the previous consent of the church; and as the lot must be cast to sanction their union, each receives his partner as a divine appointment. Though the Moravians are united in one body, they are by no means illiberal in their views towards other christians, who hold what they conceive to be the essentials of religion, and pay divine adoration to Jesus Christ. In doctrine they appear to be inclined to Sabellianism. They address all their prayers to Jesu, or the Lamb, and they have been accused, not without reason, of adopting a phraseology in their hymns and prayers not consistent with the rules of decency and chastity. They are, however, a very harmless and unoffending people. They appear to be Arminians in opposition to Calvinism, and they reject the use of the term trinity, and some other popular terms and phrases.

MORDANT. In dyeing, the substance combined with the vegetable or animal fibre, in order to fix the dye stuff. It also usually modifies the colour.

MORDELLA, a genus of insects of the order coleoptera. The antennæ are thread-shaped and serrated: the head is deflected under the neck: the pappi are elevated, compressed, and obliquely blunted; and the elytra are bent backwards near the apex. There are six species.

MORMYRUS, a genus of fishes of the branchiostegeous order, the generic character is, head smooth; teeth numerous, notched; aperture of the gills linear, without a cover; gill membrane with one ray; body scaly. There are three species. The kannume has the tail bifid, obtuse; dorsal fin with 63 rays It inhabits the Nile.

MOROCCO, *maroquin*, in commerce, a fine kind of leather prepared of the skin of an animal of the goat-kind, and imported from the Levant, Barbary, &c.

MOROXYLATES, in chemistry, a genus of salts, of which there are two species, viz. 1. The moroxylate of lime found on the bark of mulberry-trees, chrystallized in short needles. Its taste resembles succinic acid. When heated it swells and emits a vapour which irritates the organs of smell. Its solution precipitates acetate of lead, nitrate of silver, and nitrate of mercury. 2. M. of ammonia, obtained by pouring carbonate of ammonia into the solution of the moroxylate of lime. This solution when evaporated, yields chrystals of moroxylate of ammonia in long, slender prisms.

MOROXYLIC *acid*, discovered by Dr. Thompson on the bark of the *morus alba* or white mulberry, growing at Palermo in Sicily. It has the taste of succinic acid; is not altered by exposure to the air; but dissolves readily in water and alcohol. It does not precipitate the metallic solutions like its salt.

MORTALITY, *bills of*, registers of the number of deaths or burials in any parish or district. The establishment of bills of mortality in great Britain, originated in the frequent appearance of the plague, which formerly made great devastations in this country, and an abstract of the number of deaths was published weekly, to shew the increase or decrease of the disorder, that individuals might not be exposed to unfounded alarms, but have some means of judging of the necessity of removal, or of taking other precautions, and government to be informed of the propriety or success of any public measures relating to the disorder.

The London bills of mortality are founded upon the reports of the sworn searchers, who view the body after decease, and deliver their report to the parish clerk. The parish clerks are required under a penalty for neglect, to make a weekly return of burials, with the age and disease of which the person died; a summary of which account is published weekly; and on the Thursday before Christmas-day, a general account is made up for the whole year.

The total number of parishes now comprehended in the London bills of mortality is 146. They are divided into the ninety-seven parishes within the walls, sixteen parishes without the walls, twenty-three out-parishes in Middlesex and Surrey, and ten parishes in the city and liberties of Westminster. They give the ages at which the persons die, and a list of the diseases and casualties by which their death was occasioned, but little dependence canbe placed on the list of diseases, except with respect to some of the most common and determinate. These bills would afford the means of ascertaining the state of population with sufficient precision, if the proportion of annual deaths to the number of the living could be accurately determined

MORTAR, a preparation of lime and sand mixed up with water, which serves as a cement, and is used by masons and bricklayers in building of walls of stone and brick. The best mortar for resisting water is made by mixing with lime, puzzolano, a volcanic sand brought from Italy. Basaltes may be substituted in its stead.

Mortar, in chemistry and pharmacy, an utensil very useful for the division of bodies by percussion, trituration, &c. Mortars are of different shapes and sizes, and the matter intended to be broken in them is struck with a pestle made of wood, iron, or marble, according to the different degrees of hardness.

Mortar, *piece*, a short piece of ordnance, considerably thick and wide; serving to throw bombs, carcasses, fire-pots, &c.

In shooting with mortars, the following general rules should be always observed. 1. To measure the distance of the object aimed at. 2. That the bombs be of equal weight, otherwise the shots will vary. 3. That the carriage be on an exact level, to prevent its leaping. 4. That the powder with which the piece is charged, be always of the same strength and quantity. 5. That the charge be equally rammed down. 6. That the wads be always of wood, tompions, or oakum. 7. That the fusees be fresh made the days on which they are to be used; and that

they be of a composition proportionable to the range of the shot in the air, so that the bomb may break at the very moment of, or soon after its fall; which composition must be such as not to be extinguished, though it fall in water, but continue burning till the bomb breaks.

MORTGAGE, signifies a pawn of lands or tenements, or any thing immoveable, laid or bound for money borrowed, to be the creditor's for ever, if the money be not paid at the day agreed upon. Mortgages are neither in fee, or for term of years, and the mortgager was formerly considered as tenant at will to the mortgagee, but he is now considered to have no legal estate whatever in the land. The last and best improvement of mortgages is the mode now adopted, where the mortage is made for a term of years, that the mortgager if he has also the fee covenants to convey the fee to the mortgager and his heirs, or any person whom he may appoint, in case of default in payment of the money. Although after breach of the condition, the estate is absolute at common law in the mortgagee; yet a right of redemption subsists in equity, which is called the equity of redemption, from the benefit of which the heir of the mortgager cannot be excluded by any covenant, provided the original intent is to mortgage the estate, and not to sell it at first. Although therefore the mortgage is forfeited, yet a court of equity will allow the mortgager at any reasonable time, to recal or redeem the estate, paying the principal, interest, and costs. This, however, is not allowed if the mortgagee has been twenty years in possession. The heir at law may have the mortgage redeemed out of the personal assets in the first place, as far as they will extend. This privilege is also allowed to the person to whom land mortgaged is devised. Where a mortgager conceals prior incumbrances upon making a second mortgage, he loses the equity of redemption.

MORTISE, or MORTOISE, in carpentry, &c. a kind of joint, wherein a hole of a certain depth is made in a piece of timber, which is to receive another piece called a tenon.

MORTMAIN, signifies an alienation of lands and tenements, to any guild, corporation, or fraternity, and their successors, as bishops, parsons, vicars, &c. which may not be done without the king's licence, and the lord of the manor; or of the king alone, if it is immediately holden of him.

MORUS, the MULBERRY-TREE, a genus of the tetrandria order, in the monœcia class of plants; and in the natural method ranking under the 53d order, scabridæ. The male calyx is quadripartite; and there is no corolla: the female calyx is tetraphyllous; there is no corolla: two styles; the calyx like a berry, with one seed. There are seven species, viz. 1. The *nigra*, or common black fruited mulberry-tree, rises with an upright, large, rough trunk, dividing into a branchy and very spreading head, rising 20 feet high or more. 2. The *alba*, or white mulberry-tree, rises with an upright trunk, branching 20 or 30 feet high. There is a variety with purplish fruit. 3. The *papyrifera*, or paper mulberry-tree of Japan, grows 20 or 30 feet high; having large palmated leaves, some trilobate, others quinquelobed· and monœcious flowers, succeeded by small black fruit. 4. The *rubra*, or red Virginia mulberry-tree, grows 30 feet high; and has large reddish berries. 5. The *tinctoria*, dyer's mulberry, or fustic, has oblong leaves, more extended on one side at the base, with axillary thorns. It is a native of Brasil and Jamaica. 6. The *Tartarica*, or Tartarian mulberry, has ovate oblong leaves, equal on both sides, and equally serrated. It abounds of the banks of the Wolga and the Tanais. 7. The *Indica* or Indian mulberry, has ovate oblong leaves, equal on both sides, but unequally serated. Considered as fruit-trees, the nigra is the only proper sort to cultivate here; the trees being not only the most plentiful bearers, but the fruit is larger and much finer-flavoured than that of the white kind.

Mulberry-trees are noted for their leaves affording the principal food of that valuable insect the silk worm. The leaves of the alba, or white species, are preferred for this purpose in Europe; but in China where the best silk is made, the worms are said to be fed with those of the morus Tartarica. The advantages of white mulberry trees are not confined to the nourishment of worms: they may be cut every three or four years like sallows and poplar-trees to make faggots; and the sheep eat their leaves in winter, before they are burnt. This kind of food, of which they are extremely fond, is very nourishing; it gives a delicacy to the flesh, and a fineness and beauty to the wool.

The *papyrifera*, or paper-mulberry, is so called from the paper chiefly used by the Japanese being made of the bark of its branches. The leaves of this species also serve for food to the silk-worm, and it is now cultivated with success in France. It thrives best in sandy soils, grows faster than the common mulberry, and at the same time is not injured by the cold.

MOSAIC, or MOSAIC-WORK, an assemblage of little pieces of glass, marble, precious stones, &c. of various colours, cut square, & cemented on a ground of stucco, in such a manner as to imitate the colours of painting.

MOSCHUS, musk, a genus of quadrupeds of the order pecora: the generic character is, horns none; front teeth in the lower jaw eight: tusks solitary, in the upper jaw exserted.

1. *Moschus moschiferus*, Tibetian musk. The size and general appearance of this animal resemble those of a small roe-buck. It measures about three feet three inches in length, about two feet three inches in height from the top of the shoulders to the bottom of the fore-feet, and two feet nine inches from the top of the haunches to the bottom of the hind feet. The upper jaw is considerably longer than the lower, and is furnished on each side with a curved tusk about two inches long. These tusks are of a different form from those of any other quadruped; being sharp-edged on their inner or lower side, so as to resemble in some degree a pair of small crooked knives: their substance is a kind of ivory, as in the tusks of the babyrussa and some other animals. The general colour of the whole body is a kind of deep iron-grey. the tips of the hairs being of a ferruginous cast. The remainder blackish, growing much paler or whiter towards the roots. The female is smaller than the male, and wants the tusks; it has also two small teats

They are hunted for the sake of their well-known perfume: which is contained in an oval receptacle about the size of a small egg, hanging from the middle of the abdomen, and peculiar to the animal. This receptacle is found constantly filled with a soft unctuous, brownish substance, of the most powerful and penetrating smell and which is no other than the perfume in its natural state As soon as the animal is killed the hunters cut off the receptacle or musk-bag, and tie it up ready for sale. As musk is an expensive drug, it is frequently adulterated by various substances. As a medicine it is held in high estimation in the Eastern countries, and has now been introduced into pretty general use, especially in those disorders which are commonly termed nervous: and in convulsive and other cases, it is often exhibited in pretty large doses with great success.

2. *Moschus Indicus*, or the Indian musk. This species is rather larger than the common or Tibetian musk, of the colour mentioned in the specific character, with the head shaped like that of a horse, upright oblong ears, and slender legs.

3. *Moschus pygmæus*, or the pigmy musk, is considerably smaller than a domestic cat, measuring little more than nine inches from the nose to the tail. Its colour is bright bay, white beneath, and on the insides of the thighs. Its shape is beautiful, and the legs are so slender as not to exceed the diameter of a swan-quill; the head is rather large, and the aspect mild. It is a native of many parts of the East Indies and the Indian Islands, and is said to be most common in Java.

MOSQUE, a temple or place of religious worship among the Mahometans. All mosques are square buildings, generally built with stone; before the chief gate there is a square court, paved with white marble, and low galleries round it, whose roof is supported by pillars. In these galleries the Turks wash themselves before they go into the mosque. In each mosque there are a great number of lamps. As it is not lawful to enter the mosque with shoes or stockings on, the pavements are covered with pieces of stuff sewed together, each wide enough to hold a row of men kneeling, sitting, or prostrate. The women are not allowed to enter the mosques. About every mosque there are six high towers, called minarets, each of which has three little open galleries, one above another; whence instead of a bell, the people are called to prayer by certain officers appointed for that purpose. Most of the mosques have a kind of hospital belonging to them, in which travellers of what religion soever, are entertained during three days. Each mosque has also a place called tarbe, which is the burying place of its founders; within which is a tomb six or seven feet long, covered with green velvet or satin, at the ends of which are two tapers, and round it several seats for those who read the Koran, and pray for the souls of the deceased.

MOSS. See Muscus.

MOTACILLA, the *wagtail* and *warbler*, a genus of birds of the order of passeres, distinguished by a straight weak bill of a subulated figure, a tongue lacerated at the end, and very slender legs.

1. The *alba* or white wagtail, frequents the sides of ponds and small streams, and feeds on insects and worms. The head, back, and upper and lower side of the neck as far as the breast are black; in some the chin is white, and the throat marked with a black crescent; the breast and belly are white. The tail is very long, and always in motion.

2. The *flava*, or yellow wagtail, migrates in the north of England, but in Hampshire, continues the whole year. The male is a bird of great beauty; the breast, belly, thighs, and vent-feathers, being of a most vivid and lovely yellow. The colours of the female are far more obscure than those of the male: it wants also those black spots on the throat.

3. The *regulus*, or gold-crested wren, is a native of Europe, and of the correspondent latitudes of Asia and America. It is the least of all the European birds, weighing only a single drachm. Its length is about four inches and a half, and the wings when spread out measure little more than six inches. On the top of its head is a beautiful orange coloured spot, called its crest which it can hide, with pleasure.

4. The *sutoria*, or taylor-bird, is a native of the East Indies. It is remarkable for the art with which it makes its nest, seemingly in order to secure itself and its young, in the most perfect manner possible, against all danger from voracious animals. It picks up a dead leaf, and sews it to the side of a living one; its slender bill is the needle, and its thread is formed of some fine fibres: the lining is composed of feathers, gossamer, and down.

5. The *luscinia*, or nightingale, exceeds in size the hedge-sparrow. The bill is brown; the irides are hazel; the head and back pale tawny, dashed with olive; the tail is of a deep tawny red; the under parts pale ash colour, growing white towards the vent; the quills are cinereous brown. The male and female are very similar. This bird the most famed of the feathered tribe for the variety, length, and sweetness of its notes, is supposed to be migratory. The female builds in some low bush or quickset hedge, well covered with foliage, for such only this bird frequents; and lays four or five of a greenish brown. The nest is composed of dry leaves on the outside, mixed with grass and fibres, lined with hair or down within, though not always alike. The female alone sits on and hatches the eggs, while the male not far off regales her with his delightful song, but as soon as the young are hatched he commonly leaves off singing, and joins with the female in the task of providing for and feeding them.

6. The *modularis*, or hedge-sparrow, a well-known bird, has the back and wing-coverts of a dusky hue, edged with reddish brown; rump of a greenish-brown; throat and breast of dull-ash-colour; the belly a dirty white; and the legs of a dull flesh-colour. The note of this bird would be thought pleasant, did it not remind us of the approach of winter.

7. The *phœnicurus*, or redstart, is somewhat less than the red-breast; the forehead is white; the crown of the head, hind part of the neck and back, are deep blue-grey; the cheeks and throat black; the breast, rump, and sides, red; and the belly is white; the two middle tail feathers are brown; the rest red; and the legs are black. The wings are brown in both sexes. This bird is migratory; coming hither in spring, and departing in autumn about October.

Their song has no great strength; yet it is agreeable enough; and they will, if taught young, imitate the notes of other birds, and sing by night frequently as well as in the daytime.

8. The *rubecula*, or red-breast, is universally known. It builds not far from the ground if in a bush; though sometimes it fixes on an outhouse, or retired part of some old building. The nest is composed of dried leaves, mixed with hair and moss, and lined with feathers. The eggs are of a dusky white, marked with irregular reddish spots: and are from three to seven in number. Insects are their general food; but in defect of these they will eat many other things. No bird is so tame and familiar as this; closely attending the heels of the gardener when he is using his spade, for the sake of worms; and frequently in winter entering houses where windows are open, when they will pick up the crumbs from the table while the family is at dinner. Above 150 other species, besides varieties, are enumerated by ornithologists.

MOTE, in law-books, signifies court, meeting, or convention, as a ward mote, burghmote, swain mote, &c.

MOTH. See Phalæna.

MOTION, has been defined to be a "change of place," or the act by which a body corresponds with different parts of space at different times. We are principally acquainted with two sorts of motion in the beings that surround us; one is the motion by which an entire body is transferred from one place to another, as that of a stone when it falls, or of a ship under sail. But, besides this, there is another kind of motion, which, though not so obvious, is yet not less common nor important. This is a motion of the parts of bodies among themselves, which though sometimes the object of our senses, yet in other cases we require the aid of reflection to be convinced of its existence. It is by this imperceptible motion that plants and animals grow, and by which the greatest number of the compositions and decompositions throughout the globe take place. The particles of the most solid bodies are also continually changing their situations. Heat expands, and cold contracts the size of all bodies. Now, we know from experience, that the temperature of bodies is constantly varying, consequently, the particles must be in continual agitation, in order to adapt themselves to the size of the body.

In considering motion, several circumstances must be attended to:

1. The force which impresses the motion.
2. The quantity of matter in the moving body.
3. The velocity and direction of the motion.
4. The space passed over by the moving body.
5. The time employed in going over this space.
6. The force with which it strikes another body that is opposed to it.

In a mechanical sense, every body, by its inertia, resists all change of state. If at rest, it will not begin to move of itself; and if motion is communicated to it by another body, it will continue to move for ever uniformly, except it is stopped by an external agent. It is true, we do not see any instances of bodies continuing to move for ever, after being once put in motion; but the reason of this is, that all the bodies which we see are acted upon in such a manner, as to have their motion gradually destroyed by friction, or the rubbing of other bodies upon them. For, if you diminish the friction by any means, the motion will continue much longer; but as it is impossible to destroy it entirely, it diminishes, and at last destroys, all motions on the surface of the earth. To put a body in motion, therefore, there must be a sufficient cause. These causes are called motive powers, and the following are those generally used in mechanics: the action of men and other animals, wind, water, gravity, the pressure of the atmosphere, and the elasticity of fluids and other bodies.

The velocity of motion is estimated by the time employed in moving over a certain space, or by the space moved over in a certain time. To ascertain the degree of this swiftness or velocity, the space run over must be divided by the time. For example: suppose a body moves over 1000 yards in 10 minutes, its velocity will be 100 yards per minute. If we would compare the velocity of two bodies A and B, of which A moves over 54 yards in 9 minutes, and B 96 yards in 6 minutes, the velocity of A will be to that of B, in the proportion of 6 (the quotient of 54 divided by 9) to 16 (the quotient of 96 divided by 6.)

To know the space run over, the velocity must be multiplied by the time; for it is evident, that if either the velocity or the time is increased, the space run over will be greater.

A body in motion must every instant tend to some particular point. It may either tend always to the same point, in which case the motion will be in a straight line: or it may be continually changing the point to which its motion is directed, and this will produce a curvilinear motion.

If a body is acted upon only by one force, or by several in the same direction, its motion will be in the same direction in which the moving force acts; as the motion of a boat which a man draws to him with a rope. But if several powers, differently directed, act upon it at the same time, as it cannot obey them all, it will move in a direction somewhere between them. This is what is called the composition and resolution of motion, and is of the utmost importance in mechanics.

Suppose a body A, plate XXVI, fig. 3, to be acted upon by another body in the direction AB, while at the same time it is impelled by another in the direction AC, then it will move in the direction AD; and if the lines AB, AC, are made of lengths proportionate to the forces, and the lines CD, DB, drawn parallel to them, so as to complete the parallelogram ABDC, then the line which the body A will describe, will be the diagonal AD; and the length of this line will represent the force with which the body will move.

If we know the effect which the joint action of two powers has upon a body, and the force and direction of one of them, it is easy to find that of the other. For, suppose AD to be the direction and force with which the body moves, and AB to be one of the impelling forces, then, by completing the parallelogram, the other power AC is found.

Motion is said to be accelerated, if its velocity continually increases; to be uniformly accelerated, if its velocity increases equally in equal times.

Motion is said to be retarded, if its velocity continually decreases; and to be uniformly retarded, if its velocity decreases equally in equal times.

If you suppose a body to be put in motion by a single impulse, and moving uniformly, to receive a new impulse in the same direction, its velocity will be augmented, and it will go on with the augmented velocity.

If at each instant of its motion it receives a new impulse, the velocity will be continually increasing; and if this impulse is always equal, the velocity will be uniformly accelerated. The regularly increasing velocity with which a body falls to the earth, is an instance of accelerated motion, which is caused by the constant action of gravity.

To illustrate the doctrine of accelerated motion, let us suppose that, in the triangle ABC, fig. 4, AB expresses the time which a body takes to fall, and BC the velocity acquired at the end of the fall. Let AB be divided into a number of equal parts, indefinitely small, and from each of these divisions suppose lines, as DE, drawn parallel to BC; it is evident that those lines will express the velocities of the falling body in the several respective points of time, each being greater than the other, by a certain quantity of increase, which follows from the nature of the triangle. Now, the spaces described in the same time, are in proportion to the velocities; and the sum of the spaces described in all the small portions of time, is equal to the space described from the beginning of the fall. But the sum of all the lines parallel to BC, taken indefinitely near to each other, constitutes the area of the triangle. Therefore the space described by a falling body, in the time expressed by AB, with an uniformly accelerated velocity, of which the last degree is expressed by BC, will be represented by the area of the triangle ABC.

Let us now suppose that gravity ceased to act, and that the body moved during another portion of time, EF, equal to AB, with the acquired velocity represented by BC. As the space moved over is found by multiplying the velocity by the time, the rectangle CF will represent the space moved over in this second portion of time, which is twice the triangle ABC, and consequently twice the space it moved over with the accelerating velocity in the same time. But if we suppose gravity still to act, besides the space CF, which it would have moved over by its acquired velocity, we must add the triangle CGH, for the effect of the constant action of gravity; therefore, in this second portion of time, the body moves over three times the space as in the first. And as the velocities of falling bodies are in proportion to the spaces run over, it follows, that the velocities in each instant increase, as the numbers 1, 3, 5, 7, 9, &c.

It is found by experiment, that a body falling from a height, moves at the rate of $16\frac{1}{12}$ feet in the first second; and, as has been shewn above, acquires a velocity of twice that, or $32\frac{1}{6}$ feet in a second. At the end of the next second, it will have fallen $64\frac{1}{3}$ feet, the space being as the square of the time; the square of 2 is 4, and 4 times $16\frac{1}{12}$ is $63\frac{1}{3}$. By the same rule you may find, that in the third second it will fall 144 feet; in the next 256 feet, and so on. It is to be understood, however, that by this velocity is meant what bodies would acquire, if they were to fall through a space where there was no air; for its resistance considerably diminishes their velocity in falling. It has been already shewn, that if two forces act uniformly upon a body, they will cause it to move in a straight line; but if one of the forces is not uniform, but either accelerating or retarding, the moving body will describe a curve line.

The force with which a body moves, or which it would exert upon another body opposed to it, is always in proportion to its velocity multiplied by its weight, or quantity of matter. This force is called the momentum of the body: for if two equal bodies move with different velocities, it is evident that their forces, or momenta, are as their velocities; and if two bodies move with the same velocity, their momenta are as the quantities of matter; therefore, in all cases, their momenta must be as the products of their quantities of matter, and their velocities. This rule is the foundation of mechanics.

In consequence of the vis inertiæ of matter all motion produced by one force only acting upon a body, must be rectilinear; for it must receive some particular direction from the power that impressed it, and must retain that direction until it is changed by some other power. Whenever, therefore, we see a body moving in a curvilinear direction, we may be certain that it is acted upon by two forces at least. When one of the two forces ceases to act, the body will move again in a straight line. Thus a stone in a sling is moved round by the hand, while it is pulled towards the centre of the circle, which it describes, by the string: but when the string is let go, the stone flies off in a tangent to the circle.

Every body moved in a circle has a tendency to fly off from its centre, which endeavour of receding is called the centrifugal force: and it is opposed to the centripetal force; or that which, by drawing bodies towards the centre, makes them revolve in a curve. These two forces are called together central forces.

The centre of gravity of a body is that point about which all the parts of a body do in any situation exactly balance each other. Hence, if a body is suspended or supported by this point, the body will rest in any position in which it is put. Also, whatever supports that point bears the weight of the whole body; and while it is supported, the body cannot fall. We may therefore consider the whole weight of a body as centered in this point.

The common centre of gravity of two or more bodies is the point about which they would equiponderate, or rest, in any position.

If a line is drawn from the centre of gravity of a body, perpendicular to the horizon, it is called the line of direction; because it is the line that the centre of gravity would describe, if the body fell freely.

It is the property of this line, that while it falls within the base upon which the body stands, the body cannot fall; but if it fall without the base, the body will tumble. Thus the inclining body ABCD, fig. 5, whose cen-

tre of gravity is E, stands firmly on its base CDIK, because the line of direction EF falls within the base. But if a weight, as ABGH, is laid upon the top of the body, the centre of gravity of the whole body and weight together is raised to L; and then, as the line of direction LD falls without the base at D, the centre of gravity is not supported, and the whole body and weight will tumble down together.

The broader the base, and the nearer the line of direction is to the middle or centre of it, the more firmly does the body stand. On the contrary, the narrower the base, and the nearer the line of direction is to the side of it, the more easily may the body be overthrown, a less change of position being sufficient to remove the line of direction out of the base in the latter case than in the former.

From what has been said, it plainly appears, that if a plane CD on which a heavy body is placed, was elevated at C, the body would slide down upon the plane, whilst the line of direction falls within the base; but it would tumble or roll down when that line falls without the base. Thus the body A, fig. 6, would only slide down, whilst the body B would roll down upon it. If a body is suspended freely from different centres, its centre of gravity will be in the intersection formed by lines drawn from those centres perpendicular to the horizon. Hence we obtain an easy practical method of finding the centre of gravity of any irregular plane figure. Suspend it by any point, with the plane perpendicular to the horizon, and from the point of suspension hang a plumb-line, and draw a line upon the body where the string passes over; do the same for any other point of suspension, and where the two lines meet must be the centre of gravity; for the centre of gravity being in each line, it must be at the point where they intersect.

Motion, *spontaneous* or *muscular*, is that performed by the muscles at the command of the will.

Motion, *natural* or *involuntary*, that effected, without any such command, by the mere mechanism of the parts, such as the motion of the heart, pulse, &c.

Motion, *intestine*, the agitation of the particles of which a body consists.

Motion, in music, the manner of beating the measure, to hasten or slacken the time of the words or notes.

MOVEMENT, in mechanics, a machine that is moved by clock-work.

MOULD, or **Mold**, in the mechanic arts, &c. a cavity cut with a design to give its form or impression to some softer matter applied therein, of great use in sculpture, foundery, &c.

Moulds, in the manufacture of paper, are little frames composed of several brass or iron wires, fastened together by another wire still finer. Each mould is of the bigness of the sheet of paper to be made, and has a rim or ledge of wood to which the wires are fastened; these moulds are more usually called frames, or forms.

Moulds *for leaden bullets*, are little iron-pincers, each of whose branches terminates in an hemispherical concavity, which when shut, form an entire sphere: in the lips or sides where the branches meet, is a little jet or hole through which the melted lead is conveyed.

Moulds, *glaziers'*. The glaziers have two kinds of moulds, both serving to cast their lead. In the one they cast the lead into long rods or canes fit to be drawn through the vice, and the grooves formed therein; this they sometimes call ingot-mould. In the other they mould those little pieces of lead a line thick, and two lines broad, fastened to the iron-bars; these may be also cast in the vice.

Moulds, among plumbers, are the tables whereon they cast the sheets of lead. These they sometimes call simple tables; besides which they have other real moulds wherewith they cast pipes without soldering.

Moulds, used in basket-making are very simple, consisting ordinarily of a willow, or osier, turned or bent into an oval, circle, square, or other figure, according to the baskets, panniers, hampers, hats, and other utensils intended. On these moulds they make or more properly measure all their work, and accordingly they have them of all sizes, shapes, &c.

Moulds, among tallow-chandlers, are of two kinds; the first for the common dipped candles, being the vessel wherein the melted tallow is disposed, and the wick dipped; this is of wood, of a triangular form, and supported on one of its angles, so that it has an opening of near a foot at top; the other, used in the fabric of mould candles, is of brass, pewter, or tin; here each candle has its several moulds.

Mould, among gold-beaters, a certain number of leaves of vellum, or pieces of guts, cut square, of a certain size, and laid over one another, between which they put the leaves of gold and silver, which they beat on the marble with the hammer. They have four kinds of moulds, two whereof are of vellum, and two of gut: the smallest of those of vellum consists of forty or fifty leaves, the largest contains an hundred; for the others, each contains five hundred leaves. The moulds have all their several cases, consisting of two pieces of parchment, serving to keep the leaves of the mould in their place, and prevent their being disordered in beating.

Mould, in agriculture, a loose kind of earth, every where obvious on the surface of the ground, called also natural or mother-earth; by some also loam.

MOULDINESS, a term applied to bodies which corrupt in the air, from some hidden principle of humidity therein; and whose corruption shews itself by a certain white down, or lanugo, on their surface, which, viewed through a microscope, appears like a kind of meadow, out of which arise herbs and flowers, some only in the bud, others full blown, and others decayed, each having its root, stalk, and other parts.

MOULDING, any thing cast in a mould, or that seems to have been so, though in reality it were cut with a chisel, or the axe.

Mouldings, in architecture, projectures beyond the naked wall, column, wainscot, &c. the assemblage of which forms cornices door-cases, and other decorations of architecture.

MOUNTAINS. Elevations consisting chiefly of clay, sand, or gravel, are called hills. Those which consist chiefly of stone are called mountains. Mountains are divided into primeval, that is, of equal date with the formation of the globe, and secondary or alluvial. Among primeval, those of granite hold the first place. The highest mountains and

most extensive ridges throughout the globe are of that kind; as the Alps and Pyrenees in Europe; the Altuischan, Uralian, and Caucasus, in Asia; and the Andes, in America. The highest of them never contain metallic ores; but some of the lower contain ores of copper and tin. The granite next the ore always bounds in mica. Petrefactions are never found in these primeval mountains.

That the formation of these mountains preceded that of vegetables and animals, is justly inferred from their containing no organic remains, either in the form of petrefaction or impression. Naturalists are agreed, that granites were formed by chrystallization. This operation probably took place after the formation of the atmosphere, and the gradual excavation of the bed of the ocean, when the dry land appeared. For, by means of the separation of the aeriform fluids which constitute the atmosphere, the evaporation of part of the water into the atmosphere, and the gradual retreat of the remainder, the various species of earths, before dissolved or diffused through this mighty mass, were disposed to coalesce; and among these the siliceous must have been the first, as it is the least soluble; but as the siliceous earth has an affinity to the other earths with which it was mixed, some of these must have united in various proportions, and thus have formed, in distinct masses, the feltspar, schorl, and mica, which compose the granite. Calcareous earth enters very sparingly into the composition of this stone; but as it is found in schorl, which is frequently a component part of granite, it follows that it must be one of the primitive earths, and not entirely derived from marine exuviæ, as some have supposed. Quartz can never be supposed to be a product of fire; for in a very low heat it bursts, cracks, and loses its transparency, and in the highest degree of heat that we can produce, is infusible, so that in every essential point it is different from glass, to which some have compared it. As granite contains earths of every genus, we may conclude, that all the simple earths are original.

Mountains which consist of limestone or marbles of a granular or scaly texture, and not disposed in strata, seem also to have preceded the creation of animals, for no organic traces are found in them. Some of those which consist of argillaceous stones, and some of the siliceous, contain also no organic remains.

Alluvial mountains are evidently of posterior formation, as they contain petrefactions and other vestiges of organic substances, and these are always stratified. Mountains, as to structure, are entire, stratified, and confused. Entire mountains are formed of huge masses of stone, without any regular fissures, and are mostly homogeneous. The stratified mountains are those whose mass is regularly divided by joints or fissures: these are called horizontal, rising, or dipping. Homogeneous stratified mountains consist chiefly of stones of the argillaceous genus, or of the fissile compound species of the siliceous genus, as metallic rock; sometimes of lime-stone of a granular or scaly texture, in which no animal vestiges appear. This limestone reposes on the argillaceous or siliceous strata: sometimes the argillaceous are covered with masses of granite, sometimes of lava. These mountains, particularly those of gneiss, metallic rock, and horn-stone, are the chief seat of metallic ores Heterogeneous, or compound stratified mountains, consist of alternate strata of various species of stones, earth, sands, &c. The limestone here is always of the laminar, and not of the granular or scaly kind; and when it contains any ore, it is placed between its laminæ. Coal, bitumen, petrefactions, and organic impressions, are found in these mountains; also salts and calamine.

There are other mountains, which cannot properly be called stratified, as they consist only of three immense masses, the lowest granite, the middle argillaceous, and the upper limestone. Metallic ores are found in the argillaceous part, or between it and the limestone.

Confused mountains consist of stones heaped together without order, their interstices filled with clay, sand, and mica. They scarcely ever contain any ore. Besides these, there are many mountains in different parts of the world, which derive their origin from volcanoes; but of these it will be necessary to treat in a succeeding article. The height of mountains is usually calculated by means of the barometer. For this purpose two columns of mercury, or barometers, are provided, and one is kept at the foot of the mountain while the other is carried to its summit. The highest mountains are those which are situated at or near the equator; and the Andes are generally allowed to be the highest of these.

The line of congelation, or of perpetual frost, on mountains, is calculated at 15,400 feet, at or near the equator; at the entrance of the temperate zone, at 13,428; on Teneriff, at 1000; in Auvergne (lat. 45) 6,740; with us (lat. 52) 5,740. On the Andes, vegetation ceases at 14,697 feet; and on the Alps, at 9,585. The air is so dry in these elevated situations, that M. d'Arcet observed, that on the Pic de Midi, one of the Pyrenees, salt of tartar remained dry for an hour and a half, though it immediately moistened in the same temperature at the bottom of the mountain.

MOUNTING, in military affairs, signifies going upon duty. Thus, mounting a breach, is running up to it; mounting the guard, is going upon guard; and mounting the trenches, is going upon duty in the trenches; but mounting a cannon, mortar, &c. is the setting it on its carriage, or the raising its mouth.

MOUSE. See Mus.

MOUTH. See ANATOMY.

MUCILAGE, a glutinous matter obtained from vegetables, transparent and tasteless, soluble in water, but not in spirit of wine. It chiefly consists of carbon, hydrogen, and a small quantity of oxygen.

MUCUS, a fluid secreted by certain glands, and serving to lubricate many of the internal cavities of the body. In its natural state it is generally limpid and colourless; but from certain causes, will often assume a thick consistence and whitish colour like pus. Strong sulphuric acid and water, diluted sulphuric acid, and caustic alkaline lixivium and water, will serve to distinguish pus from mucus; the vitriolic acid separates it from coagulable lymph and alkaline lixivium from serum. Hence, when a person has any expectorated matter, the decomposition of which he wishes

to ascertain, let him dissolve it in vitriolic acid, and in caustic alkaline lixivium; and let him add pure water to both solutions. If there is a fair precipitation in each, he may be assured that some pus is present. But if there is a precipitation in neither, it is a certain test that the mixture is entirely mucus. If the matter cannot be made to dissolve in alkaline lixivium by time and trituration, we have also reason to believe that it is pus.

MUCUS, *nasal:* this name is given to a liquid which is secreted in the cavities of the nose and is discharged outwardly; either by the nostrils in the form of drops, or in that of masses more or less thick; or by the fauces when it descends by the posterior part of the nasal cavities, in which it is thrown out by spitting. The nasal mucus is at first liquid, clear and limpid, a little viscid and adhesive, without smell, of a saline and acrid taste. This liquid, being always exposed to the air which continually passes through the nostrils is constantly thicker, more viscid, and more adhesive, than the tears, and the carbonate of soda which it contains, whilst the latter contains only soda, announces that the air deposits in it a part of the carbonic acid which it contains, especially as it is expired out of the lungs. When it becomes thick in the air, frequently assumes in it the form of small, dry, brilliant, and, as it were, micaceous plates. The nasal mucus experiences no real petrifaction in the air. Water does not dissolve it. Acids thicken it when they are concentrated and employed in small proportions; but when we add a larger quantity, they redissolve, and give it different shades of colour. The mucus of the nostrils maintains the softness of the membranaceous sides of the nasal cavities. It moderates the too great sensibility of the nervous papillæ; stops and fixes the odorous bodies, and blunts their too great activity. It likewise purifies the air that is respired, by taking from it the pulverulent particles which it carries along with it, and which would be more hurtful in the lungs.

MUFFLE. A small earthen oven, made and sold by the crucible manufacturers. It is to be fixed in a furnace, and is useful for cupellation, and other processes which demand access of air.

MUFTI, or **Muphti**, the chief of the ecclesiastical order, or primate, of the musselman religion. The authority of the mufti is very great in the Ottoman empire; for even the sultan himself, if he would preserve any appearance of religion, cannot, without hearing his opinion, put any person to death, or so much as inflict any corporal punishment. In all actions, especially criminal ones, his opinion is required by giving him a writing, in which the case is stated under feigned names, which he subscribes with the words, *He shall*, or *shall not, be punished.* Such outward honour is paid to the mufti, that the grand seignior himself rises up to him, and advances seven steps to meet him, when he comes into his presence. The election of the mufti is solely in the grand seignior, who presents him with a vest of rich sables, &c.

MUGIL, *mullet*, a genus of fishes of the order abdominales. The generic character is, lips membranaceous; the inferior carinated within: teeth none; at the corners of the mouth an inflicted callus: gill membrane with six curved rays: body fleshy; scales large; dorsal fins two.

Gmelin notices only five species. Shaw mentions nine. *M. cephlaus*, or the common mullet is generally about 14 inches in length, and is found not only in the Northern and Mediterranean Seas, but in the Indian and Western Oceans. The mullets collect in multitudes almost close to the shores, thrusting their heads into the soft muddy bottoms in quest of aquatic insects. On the approach of summer, they ascend rivers, to a considerable distance from the sea, in order to deposit their ova. They are regarded by many as excellent food, but are not often seen at the tables of the opulent.

MULBERRY. See Morus.

MULE, in zoology, a mongrel kind of quadruped, usually generated between an ass and a mare, and sometimes between a horse and a she-ass. The mule is a sort of a monster, of a middle nature between its parents, and therefore incapable of propagating its species; so careful is nature to avoid filling the world with monsters. Mules are chiefly used in countries where there are rocky and stony roads, as about the Alps, Pyrenees, &c. See Equus.

MULES, among gardeners, denote a sort of vegetable monsters produced by putting the farina fecundans of one species of plant into the pistil or utricle of another. The carnation and sweet-william being somewhat alike in their parts, particularly their flowers, the farina of the one will impregnate the other, and the seed so enlivened will produce a plant differing from either.

MULLER, or **Mullar**, a stone flat and even at the bottom, but round at top, used for grinding of matters on a marble.

MULLERIA, a genus of the class and order diadelphia decandria. Pericarp elongated, fleshy, necklace-form, with one-seeded globules. There is one species, a tree of Surinam.

MULLET, or **Mollet**, in heraldry, a bearing in form of a flat, or rather of the rowel of a spur, which it originally represented.

MULLUS, *surmullet*, a genus of fishes of the order thoracici. Gen. char. head compressed, scaly; mouth bearded; gill-membrane three-rayed; body covered with subdeciduous scales.

Gmelin reckons six, Shaw thirteen species. 1. *Mullus ruber*, the red surmullet, is principally found in the Mediterranean and north seas, where it arrives at the length of twelve or fifteen inches; its colour is a rose-red, tinged with olive-colour on the back, and of a silvery cast towards the abdomen. It is generally considered as a very delicate fish, and is celebrated for having been the fashionable object of Roman luxury, and for which enormous sums are reported to have been sometimes given. The Romans practised a singular refinement in luxury, by first bringing the fish alive to the table in a transparent vessel, in order that the guest might contemplate the beautiful, and rapid changes of its evanescent colours during the time of its gradual expiration; after which it was prepared for their repast.

MULTILATERAL, in geometry, is applied to those figures which have more than four sides or angles, more usually called polygons.

MULTINOMIAL, or **Multinomial roots**, in mathematics, such roots as are composed of many names, parts, or members; as, $a + b + d + c$, &c. See Root.

MULTIPLE, in arithmetic, a number which comprehends some other several times, thus 6 is a multiple of 2.

Multiple ratio, or **proportion**, is that which is between multiples. If the less term of the ratio is an aliquot part of the greater, the ratio of the greater to the less is called multiple, and that of the less to the greater submultiple. A submultiple number is that contained in the multiple; thus the numbers 1, 2, and 3, are submultiples of 9. Duple, triple, &c. ratios, as also subduples, subtriples, &c. are so many species of multiple and submultiple ratios.

MULTIPLYING-GLASS, in optics, one wherein objects appear increased in number. It is otherwise called a polyhedron, being ground into several planes, that make angles with each other; through which the rays of light issuing from the same point undergo different refractions, so as to enter the eye from every surface in a different direction.

MUM, a kind of malt liquor, much drunk in Germany, and chiefly brought from Brunswick, which is the place of most note for making it.

MUMMY. See Embalming.

MUNICIPAL, in the Roman civil laws, an epithet which signifies invested with the rights and privileges of citizens.

Municipal, among us, is applied to the laws that obtain in any particular city or province; and those are called municipal officers who are elected to defend the interests of cities, to maintain their rights and privileges, and to preserve order among the Roman citizens.

MURÆNA, the *eel*, a genus of fishes of the order apodes. Gen. char. head smooth; nostrils tubular; gill membrane ten-rayed; eyes covered by the common skin; body round, smooth; and mucous spiracle behind the head or pectoral fins. There are five species according to Shaw. Gmelin enumerates nine. *M. anguilla*, or the common eel, is particularly distinguished by the steadiness and uniformity of its colours; an olive brown on the back, and silvery lustre on the sides and beneath; but more expressively still by the great elongation of its under jaw. Its general size is from two to three feet; it is slow in its growth, and considered as very long-lived. Its usual food consists of insects, worms, and the eggs of other fishes. It is viviparous, producing great numbers at a birth; but of a very diminutive size. It continues generally during the day in its hole in the banks, which it furnishes with two avenues to facilitate its escape and security. By night it ranges for food. In winter it appears to be ingulphed in mud, and remains in this state of seclusion and tranquillity, if not torpor, till the return of spring invites it to a renewal of its excursions.

M. conger, or the conger eel, is generally darker above, and more splendid beneath than the former species. It grows to its largest size in the Mediterranean, where it is sometimes found ten feet long, and of the weight of a hundred pounds. It is found in the North and American seas also: It occasionally, particularly in the spring, makes excursions into rivers, and is found in vast abundance in the Severn. Congers are extremely voracious, devouring immense quantities of the smaller fishes, and of crabs before the shell of the latter is completely formed and hardened.

MURDER, or **Murther**. See Homicide.

MUREX, in natural history a genus of univalve or simple shells, without any hinge, formed of a single piece, and beset with tubercles or spines. The mouth is large and oblong, and has an expanded lip, and the clavicle is rough. The clavicle of the murex is in some species elevated, in others depressed; and the mouth is sometimes dentated, and at others smooth; the lip also in some is digitated, in others elated, and in some laciniated; and the columella is in some smooth, in others rugose.

Murex, in zoology, a genus of insects belonging to the order of vermes testacea. This animal is of the snail kind: the shell consists of one spiral valve, rough, with membranaceous furrows; and the aperture terminates in an entire canal, either straight or somewhat ascending. From a species of murex on the coasts of Guayaquil and Guatimala in Peru, a liquor is extracted, which dyes cottons, silks, and wool of a beautiful permanent colour. The shell which contains it adheres to the rocks that are washed by the sea. It is of the size of a large walnut.

MURIATES, in chemistry, a genus of salts formed from the muriatic acid with certain bases. When heated they melt, and are volatilized, without undergoing decomposition: they are soluble in water; effervesce with sulphuric acid, and white acrid fumes of muriatic acid are disengaged; when mixed with nitric acid they exhale the odour of oxymuriatic acid.

MURIATIC ACID, the **Hydrochloric** of the French chemists. Let 6 parts of pure and well dried sea salt be put into a glass retort, to the beak of which is luted, in a horizontal direction, a long glass tube artificially refrigerated, and containing a quantity of ignited muriate of lime. Upon the salt pour at intervals 5 parts of concentrated oil of vitriol, through a syphon funnel, fixed air-tight, in the tubulure of the retort. The free end of the long tube being recurved, so as to dip into the mercury of a pneumatic trough, a gas will issue, which on coming in contact with the air, will form a visible cloud, or haze, presenting, when viewed in a vivid light, prismatic colours. This gas is muriatic acid. When received in glass jars over dry mercury, it is invisible, and possesses all the mechanical properties of air. Its odour is pungent and peculiar. Its taste acid and corrosive. Its specific gravity, according to Sir H. Davy, is such, that 100 cubic inches weigh 39 grains, while by estimation, he says, they ought to be 38.4 gr. By the latter numbers the specific gravity, compared to air, becomes 1.2590. By the former number the density comes out 1.2800

If an inflamed taper be immersed in it, it is instantly extinguished. It is destructive of animal life; but the irritation produced by it on the epiglottis scarcely permits its descent into the lungs. It is merely changed

in bulk by alterations of temperature; it experiences no change of state. When potassium, tin, or zinc, is heated in contact with this gas over mercury, one-half of the volume disappears, and the remainder is pure hydrogen. On examining the solid residue, it is found to be a metallic chloride. Hence muriatic acid gas consists of chlorine and hydrogen, united in equal volumes.

The marine acid in commerce has a straw colour; but this is owing to accidental impurity; for it does not obtain in the acid produced by the impregnation of water with the aeriform acid. The muriatic acid is one of those longest known, and some of its compounds are among those salts with which we are most familiar.

MURRAIN, or GARGLE, a contagious disease among cattle, principally caused by a hot dry season, or rather by a general putrefaction of the air, which begets an inflammation of the blood, and a swelling in the throat, that soon proves mortal, and is communicated from one to another, though it generally goes no farther than to those of the same kind. The symptoms of this disease are a hanging down and swelling of the head, abundance of gum in the eyes, a rattling in the throat, a short breath, palpitation of the heart, staggering, a hot breath, and a shining tongue.

MUS, the *rat*, a genus of mammalia of the order glires. Gen. char. fore-teeth, upper, wedge-formed; three grinders almost always each side each jaw; clavicles in the skeletons. There are forty-six species, of which the following are the most remarkable.

M. zibethicus, or the musk rat, is as large as a small rabbit, and very common in Canada; and resembles the beaver in the shape of its body, and in its instincts and character. It lives in society, and constructs its habitation with great skill and art, about two feet in diameter, and stuccoed within with particular neatness, on the border of some lake or stream. On the outside it is covered with a matting of rushes, compacted with great closeness, to preclude moisture. These animals live on roots and herbage, which, however, they do not store up in their houses, but make excursions for as they are demanded during the winter; in summer they make long progresses in pairs. They have attached to them a strong odour of musk; and walk and run with great awkwardness; are easily tamed, and highly valued for their fur.

M. decumanus, or the Norway rat, is imagined to have been imported into Europe from India, and in this country has almost extirpated the black rats, which formerly abounded in it. It subsists not only on grain and fruits, but frequently attacks poultry and rabbits, as well as various other animals. It is about nine inches long in the body, and nine more in the tail; will swim with considerable ease; is in the highest degree prolific, producing occasionally even eighteen young at a time, and breeding not unfrequently three times a year.

M. rattus, or the black rat, is considerably smaller than the former, and in this country has been nearly annihilated by it. Its habits are almost precisely similar to those of the former. It is supposed to come from the same countries; but is thought to be a native of North America also. It is reported by travellers, that in various parts of Germany it is sometimes taken and domesticated, and, having a bell put round its neck, is thus almost invariably found to alarm all others of its species from the vicinity.

M. amphibius, or the water rat, inhabits both the temperate and cold climates of Europe and Asia, frequenting the banks of rivers, in which it burrows. It subsists on frogs, and roots, and other vegetable substances; swims with great speed, and can remain under water a considerable time. It is never known to infest houses.

M. lemmus, or the leming These animals are sometimes five inches long in the body, and in some countries, (as Siberia), only three. They abound in the mountainous districts of Norway and Lapland. In their general habits they are not particular, residing in a dispersed manner. On certain occasions, however, they descend into the plains in innumerable and formidable multitudes.

M. œconomus, or the œconomic rat, resembles the leming in the circumstance of irregular migrations. These are met with particularly in Siberia, burrowing with the greatest skill, and forming considerable magazines of provisions. They are about five inches and a quarter in their whole length. In their migrations they swim over rapid rivers, preserving a course directly to the west, and experiencing extreme fatigue and peril, to which immense numbers of them become victims. A single party has been so numerous as to take two hours in passing before the astonished spectator. Scarcity of food is supposed the grand impulse to these progresses. The inhabitants of Kamtschatka rob the hoards of these animals in winter.

M. cricetus, or the hamster, is a species of the pouched rats, and the sole European species of that description. The pouches are one on each side of the mouth, and when filled, are like two blown bladders. These animals are found in Poland and Russia, and are extremely injurious by the quantities of grain which they devour, and carry off for their autumnal store in their pouches. The structure of their habitations is very curious. The females arrange their mansions differently from the males, and never reside with them. As winter approaches, they seclude themselves completely, and enjoy their stores, which are generally consumed when winter reigns in full rigour, about which time they roll themselves up and continue till spring in a state of profound slumber, or torpor. Their bodies are cold, the fat coagulated, and their limbs stiffened, and they may be opened without awaking them. The heart beats only fifteen times in a minute, while in the summer its pulsations are 150 in the same time. The waking of the hamsters from their lengthened sleep is very gradual, occupying sometimes no less than two hours. These animals are unsocial, fierce, and malignant. They attack every weaker creature, and very frequently destroy each other.

M. musculus, or the common mouse, inhabits almost every part of the world, is shy and timid, but not ferocious. It produces generally from six to ten at a birth, and breeds several times in a year. Its skin is sleek, and its eyes

are bright and lively; its limbs are neatly formed, and its movements are extremely agile. It is occasionally seen of perfect whiteness. It haunts the habitations of man, from which it is scarcely ever found at any considerable distance, and in which it commits no trifling depredations.

M. sylvaticus, or the long-tailed field-mouse, is somewhat larger than the former, and of a yellowish brown colour. It feeds on acorns, fruits, and grain, and lays up magazines in its burrow for the winter. It is found principally in dry grounds: is common in all the temperate regions of Europe, and is particularly abundant and destructive in France, where it is stated to commit very great waste. Under a scarcity of the usual supplies, these animals are supposed to destroy each other.

M. messorius, or the harvest mouse, is the smallest of British quadrupeds, weighing only the sixth part of an ounce. Its nest is most artificially platted of the blades of wheat, and is of the size of a cricket ball, the opening to it being closed up so skilfully, as to be almost imperceptible. Such is its compactness, that it may be rolled over the table without derangement. One found of this description contained eight young, and appeared completely full without the dam. In the winter these animals burrow deep in the earth, but their favourite habitation is the corn-stack.

M. socialis, social mouse. The social mouse is a native of the Caspian deserts between the Volga and the Yaik, and the country of Hiscania. It lives in low sandy situations, in large societies; the ground in many places being covered with the little hillocks formed by the earth cast out in forming the burrows, which are about a span deep, with eight or more passages. The animals are always observed to live in pairs, or with a family; they are fond of tulip roots, which form a principal article of their food.

M. typhlus, blind rat. This is perhaps one of the largest and most remarkable of its tribe, measuring between seven and eight inches in length, and being entirely destitute both of eyes and tail,

MUSA, the *plantain tree*, a genus of the monœcia order, in the polyandria class of plants, and in the natural method ranking under the eighth order, scitamineæ. There are three species.

1. *Musa paradisiaca*, is cultivated in all the islands of the West Indies, where the fruit serves the Indians for bread; and some of the white people also prefer it to most other things, especially to the yams and cassada bread. The plant rises with a soft stalk 15 or 20 feet high; the lower part of the stalk is often as large as a man's thigh, diminishing gradually to the top, where the leaves come out on every side: these are often eight feet long, and from two to three broad, with a strong fleshy mid-rib, and a great number of transverse veins running from the mid-rib to the borders. This tree is cultivated on a very extensive scale in Jamaica, without the fruit of which, the island would not be habitable, as no species of provision could supply their place.

2. *Musa sapientum*, the banana tree. This species differs from the preceding in having its stalks marked with dark purple stripes and spots. The fruit is shorter, straighter, and rounder; the pulp is softer, and of a more luscious taste. It is never eaten green; but when ripe it is very agreeable, either eaten raw or fried in slices as fritters; and is relished by all ranks of people in the West Indies. Both these plants were carried to the West.

2. *Musa troglodytarum*, has a scarlet spathe and scarlet berry, but not eatable.

MUSCA, in natural history, the *fly*, a genus of insects of the order diptera: mouth with a soft exserted fleshy proboscis, and two equal lips; sucker furnished with bristles; feelers two, very short; antennæ generally short. This is a very numerous genus, not fewer than a thousand species have been enumerated. They are divided into sections; *viz.* A. with short feelers; and B. without feelers. These sections are again separated into others. The larva in the different tribes of flies differs far more in habit than the complete insects, some being terrestrial, and others aquatic. Those of the common kinds are emphatically distinguished by the title of maggots, and spring from eggs deposited on various putrid substances. Several of the aquatic kinds are of singularly curious formation, and exhibit wonderful examples of the provision ordained by nature for the preservation of even the meanest of animals. The general form of the pupa is that of an oval, differently modified, according to the species, and formed by the external skin of the larva. Some species cast their skin before their change into the pupa state. One of the most remarkable species is *M. chamæleon*, which is a large black fly, with a broad, flattish abdomen, having the sides of each segment yellow, forming so many abrupt semi-bands across that part. It proceeds from an aquatic larva, two inches and a half in length, which is common in stagnant waters in the summer months, and passes into its chrysalis state without casting its skin, which dries over it. *M. tenax* is a remarkable insect, about the size of a drone, of a brown colour, with transparent wings. It proceeds from a larva of a very singular appearance, being a long-tailed brown maggot, about three quarters of an inch in length, which is seen in muddy stagnant waters, drains, and other places of the dirtiest description. The feet are wonderfully calculated for enabling the animal to climb perpendicular places, in order to seek some proper situation to undergo its change into chrysalis, being very broad, and beset on their under surface with numerous small hooked claws. The larva commonly changes to a pupa about the end of August, the skin contracting and drying round the body. After remaining in this state about a fortnight, it gives birth to the complete insect. It is common in the month of September, and is often mistaken for a drone. Among the bristly flies is the *M. canaria*, or common blow-fly, which deposits its eggs on animal flesh, either fresh or putrid. The larva, or maggots, hatch in the space of a few hours. When full grown, which happens in eight or ten days, they are of a yellowish colour, with a slight tinge of pale red. When the animal changes to a pupa, the skin dries round it, and the whole assumes a completely oval form, and a reddish colour. In ten days after the fly emerges.

M. vivipara greatly resembles the preceding, and is found in similar situations, but is viviparous, disclosing small ready-formed larvæ instead of eggs, which in this species are hatched internally.

MUSCI, in botany, *mosses*, one of the seven families, into which Linnæus divided all vegetables. The characteristics of mosses are, anthers without filaments; male flower constituted by the presence of the anthers, placed apart from the female, either on the same or distinct roots; female flower deprived of the pistillum; the seeds devoid of both lobes, and proper coverings. These plants constitute the second order of the class cryptogamia. This order is subdivided into eleven genera, from the presence or absence of the calyx, which in these plants is a veil that is placed over the tops of the stamina, and denominated calyptra, from the sexes of the plants, which bear male and female flowers, sometimes on the same, sometimes on distinct roots, and from the manner of growth of the female flowers, which are sometimes produced singly, sometimes in bunches or cones.

Musci, is also the name of the fifty-sixth order in Linnæus's Fragments of a Natural Method, consisting of genera, which are exactly those of the second order in the class cryptogamia. These plants resemble the pines and firs, and other evergreens in that class, in the form and disposition of their leaves, and manner and growth of the female flowers, which are generally formed into a cone. They frequently creep and extend themselves like a carpet upon the ground, trees and stones, collected into bunches or tufts. Few of the mosses are annual plants; being mostly perennial and evergreens. Their growth is slow; though preserved dry several years, they resume their original verdure upon being moistened. They delight in a cool moist situation, and northerly exposure, where they are screened from the sun. The roots are fibrous, slender, branched, and short. The stems and branches are cylindric, and weak, creeping on the ground, and striking root on every side.

MUSCICAPA, or FLY-CATCHER, a genus of birds belonging to the order of passeres. The bill is flatted at the base, almost triangular, notched at the upper mandible, and beset with bristles; the toes, generally, divided as far as their origin. There are 97 species; the most remarkable are:

1. The *grisola*, or spotted fly-catcher, about five inches and three quarters long. The head is large, of a brownish hue, spotted obscurely with black: the back is of a mouse-colour; the wings and tail are dusky; the breast and belly white. It is a bird of passage; appears here in the spring, breeds with us, and departs in September. It lays four or five pale eggs marked with red. It feeds on insects, and collects them on the wing.

2. The *flabellifera*, or fan-tailed fly-catcher, is in length six inches and a half: the head is black, which colour descends on the back part lower than the nape, whence it passes forward in a narrow collar to the throat; the chin, throat, and sides of the neck are white. This species inhabits the southern isles of New Zealand; where it is seen constantly hunting after insects, and flies always with its tail in shape of a fan.

3. The *caribonensis*, or cat-bird, is somewhat larger than a lark; length eight inches; bill black; the upper parts of the body and wings are of a deep brown; the under ash-coloured; the crown of the head is black; the tail is blackish; and the legs are brown. This species is found in Virginia.

4. The *rubicolius*, purple-throated fly-catcher, is about the size of a blackbird; the whole plumage is black, except the chin, throat, and fore part of the neck, on which is a large bed of beautiful crimson, inclining to purple; the legs are black. These birds inhabit Cayenne and other parts of South America. They feed on fruits and insects; and are lively birds, always in action.

MUSCLE, See ANATOMY.

MUSCLES, *Insertion and force of the*. Plate XXVI figs. 3 and 9. The all-wise Author of nature has furnished animals with limbs, moveable about the joints by means of muscular cords, inserted near the joint or centre of motion. In order to calculate the force of any muscle, we are to consider the bones as levers; and then the power or force of the muscle will be always to the resistance or weight it is capable of raising, as the greater distance of the weight from the centre of motion is to the lesser distance of the power. Hence, it being found by experiments, that a robust young man is able to suspend a weight R, equal to twenty-eight pounds, when the arm is extended in a supine and horizontal situation, we have this proportion, viz. the force of the muscle I D is to the weight R, = 28 lb, as the distance D C is to the distance I C. But it is found, that D C, the length of the cubit and hand, is more than twenty times greater than I C, the distance of the muscle from the centre of motion. Therefore the force of the muscle I D. must be more than twenty times greater than the weight R, or more than 28 × 20 = 560 lb.

Again, to find the force which the biceps and brachiæus muscles exert, when the humerus D A is perpendicular to the horizon, we are first to consider what weight a man is capable of sustaining in this posture, viz. R = 35 pounds, and next the quantity of the distances C B, C I, which in this case are as 16 to 1. Therefore the force of these muscles is to the weight R = 35 pounds, as the distance C B = 16 is to the distance I C = 1; or the force is equal to 560, as before.

But what appears most wonderful is, the force of the muscles that move the lower jaw; which, when taken altogether, do not in a man exceed the weight of 1 pound, and yet exert a force equal to 534 pounds, and in mastiff-dogs, wolves, bears, lions, &c. their force is vastly superior, so as to break large bones, as they practise daily in their feeding.

MUSES, certain fabulous divinities amongst the Pagans, supposed to preside over the arts and sciences: for this reason it is usual for the poets, at the beginning of a poem, to invoke these goddesses to their aid. Some reckon the muses to be no more than three, viz. Mneme, Aœde, and Melete; that is, memory, singing, and meditation: but the most ancient authors, and particularly Homer and Hesiod, reckon nine, viz. Clio, which means glory; Euterpe, pleasing; Thalia, flourishing; Melpomene, attracting; Terpsichore, rejoicing the heart;

Erato, the amiable; Polyhymnia, a multitude of songs; Urania, the heavenly; and Calliope, sweetness of voice. To Clio, they attributed the invention of history; to Melpomene, tragedy; to Thalia, comedy; to Enterpe, the use of the flute; to Terpsichore, the harp; and to Erato, the lyre and lute; to Calliope, heroic verse; to Urania, astrology; and to Polyhymnia, rhetoric.

MUSEUM, a collection of rare and interesting objects, selected from the whole circle of natural history and the arts, and deposited in apartments or buildings, either by the commendable generosity of rich individuals, general governments, or monarchs, for the inspection of the learned and the great mass of the public. The term which means, literally, a study, or place of retirement, is said to have been applied originally to that part of the Royal Palace at Alexandria appropriated for the use of learned men, and the reception of the literary works then extant. According to ancient writers, they were formed into classes or colleges, each of which had a competent sum assigned for their support; and we are further informed, that the establishment was founded by Ptolemy Philadelphus, who added a most extensive library.

MUSHROOM. See AGARICUS.

MUSIC, a science which teaches the properties, dependencies, and relations of melodious sounds; or the art of producing harmony and melody by the due combination and arrangement of those sounds.

The ancient writers on this science differ greatly as to its object and extent. In general, they give to it a much wider latitude than that which it obtains with us. Under the name of music they comprehended not only the melodious union of voices and instruments, but also the dance, gesture, poetry, and even all the other sciences. Hermes defines music to be the general knowledge of order; which was also the doctrine of Plato, who taught that every thing in the universe was music.

Music, however, properly so called, only concerns the due order and proportion of sounds; and is divided into two parts, the theoretical and the practical. Theoretical music comprehends the knowledge of harmony and modulation; and the laws of that successive arrangement of sound by which air, or melody, is produced. Practical music is the art of bringing this knowledge and those laws into operation, by actually disposing of the sounds, both in combination and succession, so as to produce the desired effect; and this is the art of composition: but practical music may, in fact, be said to extend still further, and to include not only the production of melodious and harmonious composition, but also its performance; and to such a facility in execution, and nicety of expression, has this department of practical music arrived at the present day, that its professors, generally speaking, hold a truly respectable rank in the various list of modern artists; and are highly, as well as most deservedly esteemed by all lovers and patrons of musical taste and ingenuity.

MUSSÆNDA, a genus of the pentandria monogynia class and order. The cor. is funnel-form; stigma 2, thickish; berry oblong, inferior; seeds disposed in four rows. There are three species, shrubs of China.

MUSK. This substance is secreted into a bag, situated in the umbilical region of the quadruped called moschus moschifer. Its colour is brownish red; its feel unctuous; its taste bitter; and its smell aromatic and intensely strong. It is partially soluble in water, which acquires its smell: and in alcohol, but that liquid does not retain the odour of musk.

MUSKET, a fire-arm borne on the shoulder, and used in war. The length of a musket is fixed at 3 feet 8 inches from the muzzle to the pan, and it carries a ball of 29 to 2 pounds.

In fortification, the length of the line of defence is limited by the ordinary distance of a musket-shot, which is about 120 fathoms.

MUSKETOON, a kind of short thick musket, the bore of which is the thirty-eighth part of its length: it carries five ounces of iron, or seven and a half of lead, with an equal quantity of powder. This is the shortest sort of blunderbus.

MUSLIN, a fine thin sort of cotton cloth, which bears a downy nap on its surface. There are several sorts of muslins brought from the East Indies, and more particularly from Bengal.

MUST, the juice of grape, composed of water, sugar, jelly, gluten, and bitartrate of potash. From a French wine pipe of *must*, the Marquis de Bullion extracted half an ounce of sugar, and 1-16th of an ounce of tartar. Proust says, the muscadine grape contains about 30 per cent. of a peculiar species of sugar. By fermentation, it forms wine.

MUSTELA, the *otter*, a genus of quadrupeds of the order feræ: the generic character is, foreteeth upper six, erect, acuter, distinct; lower; six, obtuser, crowded, placed within; tongue smooth.

M. lutra, common otter. The common otter is found in almost every part of Europe, as well as in the colder regions of Asia; inhabiting the banks of rivers, and feeding principally on fish. The length of the otter is nearly two feet from nose to tail, and of the tail about 16 inches. Its colour is a deep brown, with a small light-coloured patch on each side the nose, and another under the chin. The otter shews great sagacity in forming its habitation: it burrows under ground on the banks of some river or lake, and always makes the entrance of its hole under water, working upwards to the surface of the earth: and before it reaches the top, makes several holts or lodges, that in case of high floods it may have a retreat, for no animal affects lying drier; and then makes a minute orifice for the admission of air. The otter is naturally a very fierce animal; and when hunted with dogs, as is sometimes the practice, will inflict very severe wounds on its antagonists. The female produces four or five young at a birth; this commonly happens early in the spring. The young otters, if taken at a very early age, may be successfully tamed, and taught by degrees to hunt for fish, and bring them to their master.

2. *M. lutreola*. the smaller otter, very much resembles the common otter, but is smaller; the body is of a dusky colour, but with a considerable cast of tawny. In size it falls short of the common otter, measuring about a foot in length. Its fur is very valuable, and next in beauty to that of the sable.

3. *M. lutris*, the sea otter, is the largest of

the otters, measuring about 3 feet from the nose to the tail, and the tail 13 inches. The colour of this species is a deep, glossy, brownish black, the fur being extremely soft and very fine; on the forehead is generally a cast of greyish or silver colour. According to Mr. Pennant, it is one of the most local animals we are acquainted with, being entirely confined between lat. 44 and 60 north; and between east long. from London. 126. to 150.; inhabiting, in great abundance, Bering's islands, Kamtschatka, the Aleutian and Fox islands, between Asia and America.

4. *M. fero*, ferret, has eyes red and fiery. It inhabits Africa. In Europe it is tamed to catch rabbits, rats, &c. It procreates twice a year, and brings forth from six to eight at a time.

M. erminea, stoat: inhabits Europe, the cold parts of Africa, Asia, and China. Body about ten inches long; hair short, which in northern climates becomes white, except the outer half of the tail, which remains black. The fur is very valuable.

MUSTER, in a military sense, a review of troops under arms, to see if they be complete, and in good order; to take an account of their numbers, the condition they are in, viewing their arms and accoutrements, &c.

MUSTER *roll*, a specific list of the officers and men in every regiment, troop, or company, which is delivered to the inspecting field-officer, muster-master, regimental or district pay-master (as the case may be) whereby they are paid, and their condition is known.

MUTE. If any person being arraigned on any indictment or appeal for felony, &c. shall upon such arraignment stand mute, or will not answer directly to the felony, he shall be convicted of the offence, and the court shall thereupon award judgment and execution, in the same manner as if he had been convicted by verdict or confession.

MUTILLA, a genus of insects, of the order hymenoptera; the generic character is, antennæ filiform; feelers four; the articulations obconic, seated on the tip of the lip; jaw membranaceous at the tip, lip projecting obconic; wings in most species obconic; body pubescent, thorax retuse behind; sting pungent, concealed. The *M. helvola* inhabits the Cape of Good Hope.

MUTINY, in a military sense, to rise against authority. Any officer or soldier who shall presume to use traitorous or disrespectful words against the king, or who shall behave himself with contempt or disrespect towards the general, or other commander-in-chief of the forces, or shall speak words tending to their hurt or dishonour, is guilty of mutiny; or, who shall begin, excite, cause, or join in, any mutiny or sedition; or, who, being present at any mutiny or sedition, does not use his utmost endeavours to suppress the same, or coming to the knowledge of any mutiny, or intended mutiny, does not, without delay, give information to his commanding officer, is guilty of mutiny.

MUTULE. See ARCHITECTURE.

MYA, the *gaper*, in zoology; a genus belonging to the order of vermes testacea, the characters of which are these. It has a bivalve shell gaping at one end; the hinge, for the most part, furnished with a thick, strong, and broad tooth, not inserted into the opposite valve. This animal is an ascidia. There are about twenty-five species. *M. declivis* has a brittle, semi-transparent shell, sloping downwards near the open end; the hinge slightly prominent. It is found about the Hebrides, where the fish is in great esteem. *M. margaritifera*, is found in mountainous rivers, and about cataracts. It is about five inches long, and half as many broad; and it is noted for producing mother of pearl and pearls; the latter is said to be a disease of the fish, analogous to the stone in the human body.

MYCTERIA, the JABIRU, a genus of birds belonging to the order of grallæ. The bill is long, bending upwards, and acute; the nostrils are small and linear; there is no tongue; and the feet have four toes. There are two species.

M. Americana, or the American jabiru, is nearly six feet in length. It abounds in the levels of Cayenne, and other parts of South America, feeds upon fish, of which it devours immense quantities, and builds in vast trees, laying only two eggs. It is extremely wild; and when young, is used for food.

M. Asiatica is likewise a very large bird, inhabits the East Indies, and feeds on snails.

MYOPES. Those who by a natural defect have the cornea and crystalline humour too convex, are called myopes. This figure, which increases the quantity of refraction, tends to render the rays of such pencils as are formed in the eye more convergent, so that the point where these same rays meet is on this side of the retina. Myopes see distinctly those objects only which are near, which send towards the eye rays more divergent, and thereby less disposed to converge, through the effect of refraction in the crystalline and other humours. This imperfection is remedied by the use of a glass slightly concave.

MYOXUS, *dormouse*, a genus of quadrupeds of the order glires: the generic character is, front-teeth two, the upper cuneated, the lower compressed; grinders four in each jaw; vibrissæ long; tail cylindric, villose, thicker towards the end; legs of equal length, fore-feet tetradactylous. These animals feed only on vegetables, and burrow in the ground, in which they continue during the winter in a torpid state. They are nocturnal, sleeping in their habitations the greater part of the day; they carry food to their mouths with their fore-paws, setting erect; and advance by leaps of several feet at a time, instead of walking. There are four species.

M. glis, or the fat, dormouse is found in Germany and Russia, and has much of the manners of a squirrel, haunting trees and feeding on fruits and nuts which it stores for its winter consumption. It was highly valued by the Romans as an article of food. It is six inches long to the tail, which is about four. It is not easily tamed.

M. muscardinus, or the common dormouse, is nearly of the size of a mouse, and inhabits thick hedges, making its nest in the hollow of some tree. It forms a hoard for the winter, during which it is for the greater part abstinent and torpid. It occasionally is roused by the intervention of temperate days, recurs to its stock, and then returns to its slumbers, till spring recovers it to daily exertion.

MYRICA, *gale* or *sweet-willow*, a genus

of the tetrandria order, in the diœcia class of plants; and in the natural method ranking under the 5th order, amentaceæ.

1. The *gale*, Dutch myrtle, or sweet-willow, grows naturally upon bogs in many places both of Scotland and England. It rises about four feet high.

2. The *cerifera*, wax-bearing myrica, or candleberry myrtle, is a native of North America. It is a small tree, about 10 or 12 feet high, with crooked stems branching forth near the ground irregularly.

There is a variety of this species of lower growth, with shorter but broader leaves, and of equal fragrance. This grows commonly in Carolina; where the inhabitants collect from its berries a wax of which they make candles, and which occasions its being called the candleberry tree. It delights in a moist soil.

MYRISTICA, *nutmeg-tree*, a genus of the diœcia syngenesia class and order. Nat. ord. of lauri. Calyx trifid; corolla none; male, filament columnar; anthers terminating, united; female, capsule superior, drupaceous, two valved; nut involved in an aril, called the mace. There are three species, of which *M. aromatica*, aromatic or true nutmeg-tree, grows to a considerable size in the East Indies.

MYRMECOPHAGA, the *ant-eater*, in natural history, a genus of Mammalia, of the order Bruta. Generic character: no teeth; tongue extensile and cylindric; mouth elongated into a form somewhat tubular; body covered with hair. They subsist on insects, and particularly that species of them from which they are designated. Thrusting their tongue into a nest of ants, the glutinous substance which exudes from it, serves to attach to it inextricably numbers of these insects, and when the animal perceives, by the exquisite feelings of the papillæ, that he has secured a sufficient number, he withdraws his tong and swallows his victims. There are seven species.

MYRMELEON, a genus of insects of the order neuroptera: the generic character is, mouth furnished with jaws, teeth two; feelers four, elongated; stemmata none; antennæ elevated, of the length of the thorax; wings deflected; tail of the male furnished with a forceps consisting of two straightish filaments. Of this genus the species history is best understood is the myrmeleon formicaleo of Linnæus, whose larva has long been celebrated by naturalists for its wonderful ingenuity, in preparing a kind of pitfal or deceptive cavity for the destruction of such insects as happen unwarily to enter it. The myrmeleon formicaleo, in its complete or fly state, bears some resemblance to a small dragon-fly, from which, however, it may readily be distinguished by its antennæ.

MYROXYLUM, a genus of the monogynia order, in the decandria class of plants. The calyx is campanulated; the superior petal larger than the rest; the germ is longer than the corolla; the legumen monospermous. There is but one species, the Peruiferum, a native of Peru and the warmer part of Africa. It is this shrub that yields the balsam of Peru, which is said to be extracted from it by coction in water. This balsam, as brought to us, is nearly of the consistence of thin honey, of a reddish brown colour inclining to black, and an agreeable aromatic flavour.

MYRRH, a gummy resinous concrete juice. The plant from which this substance is obtained, is not certainly known. According to Bruce, it belongs to the genus mimosa, and grows in Abyssinia and Arabia. It is in the form of tears. Colour reddish-yellow, sometimes transparent, but more frequently opaque. Taste brittle and aromatic. Does not melt when heated, and burns with difficulty. With water it forms a yellow solution. The solution in alcohol becomes opaque when mixed with water. By distillation it yields oil.

MYRTUS, the *myrtle*; a genus of the monogynia order, in the icosandria class of plants; and in the natural method ranking under the 19th order, hesperidæ. The calyx is quinquefid, superior; there are five petals; the berry is dispermous or trispermous. There are between fifty and sixty species. This genus is composed of small trees and shrubs; flowers some solitary, with two scales at the base; in others forming opposite corymbs or panicles, axillary or terminating. The *M. communis*, common myrtle, is a native of Asia, Africa, and the south of Europe. The *pimento*, or allspice tree, is about thirty feet in height, and two in circumference. It is a native of New Spain, and the West Indies. The flavour and fruit have an highly aromatic fragrance.

MYSTERY. This is a relative term and is of much the same import as the word *interpretation*, or the term antitype, and always refers to some obscure hint that went before, either by word, thing, or action, of which it is the real intent or meaning. Every emblematical speech or action, contains some hidden meaning beyond that which is first presented to the senses, and that internal, or secret *meaning*, once made known to us, the parable is explained, and every idea of secrecy, intricacy, or doubt is removed.

MYTHOLOGY, the history of the fabulous gods and heroes of antiquity, with the explanations of the mysteries or allegories couched therein. Lord Bacon thinks, that a great deal of concealed instruction and allegory was originally intended in most part of the ancient mythology. He observes, that some fables discover a great and evident similitude, relation, and connection, with the thing they signify, as well in the structure of the fable, as in the meaning of the names whereby the persons or actors, are characterised.

The same writer thinks it may pass for a further indication of a concealed and secret meaning, that some of these fables are so absurd and idle in their narration, as to shew an allegory even afar off; but the argument of most weight upon this subject he takes to be this, that many of these fables appear by no means to have been invented by the persons who relate them. He looks on them not as the product of the age, nor invention of the poets, but as sacred relics, as he terms them, gentle whispers, and the breath of better times, that from the tradition of more ancient nations came at length into the flutes and trumpets of the Greeks. He concludes

that the knowledge of the early ages was either great or happy; great if they by design made this use of trope and figure; of happy, if whilst they had other views, they afforded matter and occasion to such noble contemplations.

MYTILLUS, the *mussel*, a genus of insects of the vermes testacea class and order. Animal allied to an ascida; shell bivalve, rough, generally affixed by a byssus, or beard of silken filaments; hinge mostly without teeth, with generally a subulate, excavated, longitudinal line. There are between fifty and sixty species.

M. margaritiferus, which inhabits the American and Indian Seas, is about eight inches long, and something broader; the inside is beautifully polished, and produces true mother-of-pearl, and frequently the most valuable pearls. *M. edulis* inhabits Europe and Indian sea, found in large beds, adhering to other bodies by means of a long silky beard: the fish affords a rich food, but is often noxious to the constitution.

MYXINE, the *hag*: a genus of insects belonging to the order of vermes intestina. It has a slender body, carinated beneath, mouth at the extremity, cirrated: the two jaws pinnated; an adipose or rayless fin round the tail and under the belly. *M. glutinosa*, about eight inches long. It inhabits the ocean; enters the mouths of fish when on the hooks of lines that remain a-tide under water, and totally devours the whole, except the skin and bones.

N.

N, Or *n*, the thirteenth letter, and tenth consonant of our alphabet: it is a liquid, the sound of which is formed by forcing the voice strongly through the mouth and nostrils; being at the same time intercepted by applying the tip of the tongue to the fore-part of the palate, with the lips open. It suffers no consonant immediately after it, in the beginning of words and syllables; nor any before it, except *g*, *k*, and *s*, as in *gnaw*, *know*, *snow*, &c. as a numeral N stands for 900; and with a dash over it, thus $\overline{N}$ for 900,000; N, or N^{o}, stands for numero.

NABOB, properly *Nawab*, the plural of Naib, a deputy. As used in Bengal, it is the same as *Nazim*. It is also a title given to the wives and daughters of princes as well as to the princes themselves.

NABONASSAR, or *Æra of Nabonassar*, a method of computing time from the commencement of Nabonassar's reign. The epocha of Nabonassar is of the greater importance, as Ptolemy and other astronomers account their years from it.

NADIR, in astronomy, that point of the heavens which is diametrically opposite to the zenith, or point directly over our heads. The zenith and nadir are the two poles of the horizon.

NAILS, *of the fingers and toes*, consist of coagulated ablumen, with a little phosphate of lime.

NAILS, in building, &c. small spikes of iron, brass, &c. which being driven into wood, serve to bind several pieces together, or to fasten something upon them. The several sorts of nails are very numerous: as, 1. Back and bottom nails, with flat shanks to hold fast, and not open the wood. 2. Clamp-nails, for fastening the clamps in buildings, &c. 3. Clasp-nails, the heads of which, clasping and sticking into the wood, render the work smooth, so as to admit a plane over it. 4. Clench-nails, used by boat and barge-builders. 5. Clout-nails, used for nailing on clouts to axle-trees. 6. Deck-nails, for fastening of decks in ships, doubling of shipping, and floors laid with planks. 7. Dog-nails, for fastening hinges on doors, &c. 8. Flat-points, much used in shipping, and proper where there is occasion to draw and hold fast, and no conveniency of clenching. 9. Jobent nails, for nailing thin plates of iron to wood, as small hinges on cupboard doors, &c. 10. Lead-nails, for nailing lead, leather, and canvas, to hard wood. 11. Port-nails, for nailing hinges to the ports of ships. 12. Pound-nails, which are square, and are much used for pailing. 13. Ribbing-nails, principally used in ship-building, for fastening the ribs of ships in their places. 14. Rose-nails, which are drawn square in the shank, and commonly in a round tool. 15. Rother-nails, which have a full head, and are chiefly used in fastening rother-irons to ships. 16. Round-head nails, for fastening on hinges, or for any other use where a neat head is required. 17. Scupper-nails, which have a broad head, and are used for fastening leather and canvas to wood. 18. Sharp nails; these have sharp points and flat shanks, and are much used for nailing soft wood. 19. Sheathing-nails, for fastening sheathing boards to ships. 20. Square nails, which are used for hard wood, and nailing up wall-fruit. 21. Tacks, the smallest of which serve to fasten paper to wood, the middling for wool-cards, &c. and the larger for upholsterers and pumps.

Nails are said to be toughened when too brittle, by heating them in a fire-shovel, and putting some tallow or grease among them.

NAIL, is also a measure of length, containing the sixteenth part of a yard.

NAPHTHA. A native combustible liquid, of a yellowish-white colour; perfectly fluid and shining. It feels greasy, exhales an agreeable bituminous smell, and has a specific gravity of about 0.7. It takes fire on the approach of flame, affording a bright white light. It occurs in considerable springs on the shores of the Caspian Sea, in Sicily and Italy. It is used instead of oil, and differs from the petroleum obtained by distilling coal tar, only by its greater purity and lightness.

NARCISSUS, a genus of the monogynia order, in the hexandria class of plants; and in the natural method ranking under the 9th order, spathaceæ. There are six petals; the

nectarium is funnel shaped and monophyllous; the stamina are within the nectarium. There are 15 species with numerous varieties.

The bastard narcissus, or common yellow English daffodil, grows wild in great plenty in many of our woods and coppices, and under hedges, in several parts of England. Its commonness renders it of but little esteem with many; considered, however, as an early and elegant flower, of exceeding hardiness and easy culture, it merits a place in every garden, especially the double.

NARCOTICS, in medicine, soporiferous medicines, which excite a stupefaction. See Opium.

NARDUS, a genus of the monogynia order, in the triandria class of plants; and in the natural method ranking under the 4th order, gramina. There is no calyx; the coralla [illegible] bivalved. There are three species. This plant was [illegible] valued by the ancients both as an article of luxury and medicine. The unguentum nardinum was used at baths and feasts as a favourite perfume. Its value is evident from that passage of scripture, where our Saviour's head was anointed with a box of it, with which Judas found fault.

NARRATION, in oratory and history, a recital or rehearsal of a fact as it happened, or when it is supposed to have happened. Narration is of two kinds, either simple or historical, as where the auditor or reader is supposed to hear or read of a transaction at second hand; or artificial and fabulous, as where their imaginations are raised, and the action as it were is reacted before them.

NATIONAL DEBT. The stocks or public funds, are loans advanced to government, for which interest is regularly paid from revenues set apart for the purpose. This mode of raising supplies by levying taxes for the payment of the interest is called "The Funding System," and the loans thus raised, constitute "The National Debt."

The different funds or stocks are variously denominated, according to the terms on which they were established. Thus some are called the 3, some the 4 per cents, &c. and the manner of buying stock is, to give a specific sum for a nominal hundred. If for instance, the price of the 3 per cents. is 60*l.* this sum is paid for 100*l.* stock which yields a dividend of 3*l.* a year, that is 5*l.* per cent. per annum. When stocks are low, the interest is high, and *vice versa.* New loans are paid by instalments of 10 to 15 per cent. at stated periods and they generally comprehend different kinds, of stock, which together are called *Omnium.* If these be disposed of separately before all the instalments are paid, the different articles, are called *Scrip,* which is an abbreviation for *Subscription.*

NATRON. Native carbonate of soda, of which there are two kinds, the common and radiated. See Soda.

NATURAL HISTORY. The object of this branch of science may be divided into two heads; the first teaches us the characteristics, or distinctive marks of each individual object, whether animal, vegetable, or mineral; the second makes us acquainted with all its peculiarities, as to its habits, its qualities, and its uses. To assist in attaining the first, it is necessary to adopt some system of classification, in which individuals that agree in particular points may be arranged together. In this work we have adopted the Linnæan system, as the most simple and perfect that has been presented to the public. A knowledge of the second head is only gained by a patient investigation of each particular object. The study of natural history consists in the collection, arrangement, and exhibition, of the various productions of the earth. These are divided into the three grand kingdoms of nature, the boundaries of which meet together in the zoophytes. Minerals inhabit the interior parts of the earth in rude and shapeless masses. They are bodies concrete without life and sensation. Vegetables clothe the surface with verdure, imbibe nourishment through bibulous roots, breathe by leaves, and continue their kind by the dispersion of seed within prescribed limits. They are organized bodies, and have life, but not sensation. Animals adorn the exterior parts of the earth, respire and generate eggs; are impelled to action by hunger, affections, and pain: and by preying on other animals and vegetables, restrain within proper bounds and proportions the numbers of both. They have organized bodies, and have life, sensation, and the power of loco motion. Man, the governor and subjugator of all other beings is, by his wisdom alone, able to form just conclusions from such things as present themselves to his senses, which consist of natural bodies. Hence the first step of wisdom is to know these bodies; and to be able by marks imprinted on them by the God of nature, to distinguish them from each other, and to affix to every object its proper name. The Linnæan system is divided into five branches, each subordinate to the other; these are, class, order genus, species, and variety, with their names and characters. In this arrangement, the classes and orders are arbitrary, the genera and species are natural. Of the three grand divisions above referred to, the animal kingdom ranks highest in comparative estimation; next the vegetable, and last the mineral kingdom.

Animals enjoy sensation by means of a living organization, animated by a meddulary substance: perception by nerves; and motion by the exertion of the will. They have members for the different purposes of life; organs for their different senses; and faculties or powers for the application of their different perceptions. They all originate from an egg. Their external and internal structure, habits, instincts, and various relations to each other, will be found under the different genera.

The following is a brief abstract of the arrangement pursued by Linnæus in his division of the animal kingdom.

CLASS I. MAMMALIA.

ORDER.

Primates
Bruta
Feræ
Glires
Pecora
Belluæ
Cete

CLASS II. AVES.

ORDER.

Accipetres
Picæ
Anseres
Grallæ
Gallinæ
Passeres

CLASS III. AMPHIBIA.

ORDER.

Reptilia
Serpentes

CLASS IV. PISCES.

ORDER.

Apodes
Jugulares
Thoracici
Abdominales
Branchiostegi
Condropterygii

CLASS V. INSECTA.

ORDER.

Coleoptera
Hemyptera
Lepidoptera
Neuroptera
Hymenoptera
Diptera
Aptera

CLASS VI. VERMES.

ORDER.

Intestina
Mollusca
Tetascea
Zoophyta
Infusoria

NATURAL PHILOSOPHY, is that science which considers the powers of nature, the properties of nutual bodies, and their actions on one another. This science is necessarily of great extent, and the leading branches of it will be found treated under the following heads, viz. *Astronomy, Chemistry, Electricity, Galvanism, Hydraulics, Hydrostatics, Magnetism, Mechanics, Optics,* and *Pneumatics,* &c. See also EXPERIMENTAL PHILOSOPHY.

NAVIGATION, is the art of conducting a vessel from one port to another by observation of the heavenly bodies, calculation of the distance, or way, made daily, and by steering such a course, under guidance of the compass, as may lead, in the most direct manner, from the place quitted to the ship's destination.

The student of navigation should have a thorough knowledge of geography; especially of the divisions of the globe by the various circles and meridians by which it is intersected in theory. He ought also to be well acquainted with all relating to the needle; particularly what relates to the dip and variations, and be able to take an account of the ship's progress numerically, or, as it is termed in dead reckoning; and if he should possess some skill in geometry and trigonometry, he will find that his task is more easily performed, and that he will, in due time, render himself conspicuous in that branch of his profession.

The names of the two great divisions of navigation, are taken merely from the kind of charts made use of. Plane sailing is that in which the plane chart is made use of; and Mercator's sailing, or globular sailing, is that in which Mercator's chart is used.

Of plane sailing. As a necessary preliminary to our understanding this method of navigation, we shall here give the construction of the plane chart.

1. This chart supposes the earth to be a plane, and the meridians parallel to one another; and likewise the parallels of latitude at equal distances from one another, as they really are upon the globe. Though this method is in itself evidently false; yet, in a short run, and especially near the equator, an account of the ship's way may be kept by it tolerably well.

Having determined the limits of the chart, that is, how many degrees of latitude and longitude, or meridional distance, (they being in this chart the same), it is to contain: suppose from the lat. of 20° N. to the lat. of 71° N. and from the longitude of London in 0 deg. to the long. of 50° W.; then choose a scale of equal parts, by which the chart may be contained within the size of a sheet of paper on which it is intended to be drawn.

Make a parallelogram A B C D, Plate XXXVII, fig. 1, the length of which AB from north to south shall contain 51 degrees, the difference of latitude between the limits of 20° and 71°; add the breadth AD from east to west shall contain the proposed 50 degrees of longitude, the degrees being taken from the said scale, and this parallelogram will be the boundaries of the chart.

About the boundaries of the chart make scales containing the degrees, halves, and quarters of degrees (if the scale is large enough;) drawing lines across the chart through every 5 or 10 degrees.

On a straight slip of pasteboard, or stiff paper, let the scale of the degrees and parts of degrees of longitude, in the line AD, be laid close to the edge; and the divisions numbered from the right hand towards the left, being all west longitude.

Seek in a geographical table for the latitudes and longitudes of the places contained within the proposed limits.

Then, to lay down any places lay the edge to the pasteboard scale to the divisions on each side the chart, shewing the latitude of the place, so that the beginning of its divisions falls on the right-hand border AB; and against the divisions shewing the longitude of the given place make a point, and this gives the position of the place proposed; and in like manner are all the other places to be laid down.

Draw waving lines from one point to the other, where the coast is contiguous, and thus the representation of the lands within the proposed limits will be delineated.

Write the names to the respective parts, and in some convenient place insert a compass, and the chart will be completed.

2. The angle formed by the meridian and rhumb that a ship sales upon, is called, the ship's course. Thus, if a ship sails on the N.N.E. rhumb, then her course will be 22° 30′: and so of others.

3. The distance between two places lying on the same parallel counted in miles of the equator, or the distance of one place from the meridian of another counted as above on the parallel passing over that place, is called meridional distance; which, in plane sailing, goes under the name of departure.

4. Let A, fig. 2, denote a certain point on the earth's surface, AC its meridian, and AD the parallel of latitude passing through it, and suppose a ship to sail from A on the N. N. E. rhumb till she arrives at B; and through B draw the meridian BD, (which according to the principles of plane sailing, must be parallel to CA,) and the parallel of latitude BC; then the length of AB, viz. how far the ship has sailed upon the N.N.E. rhumb, is called her distance; AC or BD will be her difference of latitude, or nothing; CB will be her departure, or easting; and the angle CAB will be her course.

5. Since the distance, difference of latitude,

and departure, form a right-angled triangle, in which the oblique angle opposite to the departure is the course, and the other its complement; therefore, having any two of these given, we can (by plane trigonometry) find the rest; and hence arise the cases of plane-sailing, which are as follow.

Case I. Course and distance given, to find the difference of latitude and departure.

Example. Suppose a ship sales from the latitude of 30° 25′ north, N.NE. 32 miles (fig. 3). Required the difference of latitude and departure, and the latitude come to. Then (by right-angled trigonometry) we have the following analogy for finding the departure, viz.

As radius		10.00000
to the distance AC	32.	1.50515
so is the sine of the course A	22° 30′	9.58284
to the departure BC	12.25	1.08799

so the ship has made 12.25 miles of departure easterly, or has got so far to the eastward of her meridian. Then for the difference of latitude or northing the ship has made, we have (by rectangular trigonometry) the following analogy, viz.

As radius		10.00000
is to the distance AC	32	1.50515
so is the co-sine of course A	22° 30′	9.53284
to the difference of lat. AB	29.57	1.47077

so the ship has differed her latitude, or made of northing, 29.57 minutes.

And since her former latitude was north, and her difference of latitude also north; therefore,

To the latitude sailed from	30°, 25′ N
add the difference of latitude	00°, 29.57
and the sum is the latitude come to	30°, 54.57′ N.

By this case are calculated the tables of difference of latitude, and departure, to every degree, point, and quarter-point, of the compass.

Case II. Course and difference of latitude given, to find distance and departure.

Example. Suppose a ship in the latitude of 45° 25′ north, sails NE*b*N¼ easterly. fig. 4, till she comes to the latitude of 46° 55′ north: required the distance and departure made good upon that course.

Since both latitudes are northerly, and the course also northerly; therefore,

From the latitude come to	46°, 55′
subtract the latitude sailed from	45°, 25′
and there remains	01°, 30′

the difference of latitude, equal to 90 miles.

And (by rectangular trigonometry) we have the following analogy for finding the departure BD, viz.

As radius		10.00000
is to the diff. of latitude AB	90	1.95424
so is the tangent of course A	39° 22′	9.91401
to the departure BD	73.84	1.86828

so the ship has got 73.84 miles to the eastward of her former meridian.

Again, for the distance AD, we have (by rectangular trigonometry) the following proportion, viz.

As radius		10.00000
is to the secant of the course	39°, 22′	10.11176
so is the diff. of latitude AB	90	1.95424
to the distance AD	116.4	2.06600

Case III. Difference of latitude and distance given, to find course and departure.

Example. Suppose a ship sails from the latitude of 56° 50 north, on a rhumb between south and west, 126 miles, and she is then found by observation to be in the latitude of 55°, 40 north: required the course she sailed on, and her departure from the meridian. Fig. 5.

Since the latitudes are both north, and the ship sailing towards the equator; therefore,

From the latitude sailed from	56°, 50′
subtract the observed latitude	55, 10′
and the remainder	01°, 40′

equal to 70 miles, is the difference of latitude.

By rectangular trigonometry we have the following proportion for finding the angle of the course F, viz.

As the distance sailed DF	126	2.10037
is to radius		10.00000
so is the diff. of latitude FD	70	1.84510
to the co-sine of the course F	56°, 15′	9.74473

which, because she sails between south and west will be south 56° 15′ west, or SW*b*W. Then for the departure, we have (by rectangular trigonometry) the following proportion, viz.

As radius		10.00000
is to the distance sailed DF	126	2.10037
so is the sine of the course F	56°, 15′	9.91985
to the departure DE	104.8	2.02022

consequently she has made 104.8 miles of departure westerly.

Case IV. Difference of latitude and departure given, to find course and distance.

Example. Suppose a ship sails from the latitude of 44° 50′ north, between south and east, till she has made 64 miles of easting, and is then found by observation to be in the latitude of 42° 56′ north; required the course and distance made good.

Since the latitudes are both north, and the ships sailing towards the equator; therefore,

From the latitude sailed from	44°, 50′ N
take the latitude come to	42°, 56′
and there remains	01°, 54′

equal to 114 miles, the difference of latitude or southing.

In this case by rectangular trigonometry we have the following proportion to find the course KGL, fig. 6, viz.

As the diff. of latitude GK	114	2.05690
is to radius		10.00000
so is the departure KL	64	1.80618
to the tangent of course G	29°, 19′	9.74928

which, because the ship is sailing between south and east, will be south 29° 19′ east, or SSE½ east nearly.

Then for the distance, we shall have by rectangular trigonometry the following analogy, viz.

As radius		10.00000
is to the diff. of latitude GK	114	2.05690
so is the secant of the course	29°, 19′	10.05952
to the distance GL	130.8	2.11642

consequently the ship has sailed on a SSE½ east course 130.8 miles.

Case. 5. Distance and departure given, to find course and difference of latitude.

Example. Suppose a ship at sea sails from the latitude of 34° 24′ north, between north and west, 124 miles, and is found to to have made of westing 86 miles: required the course steered, and the difference of latitude or northing made good.

In this case, by rectangular trigonometry, we have the following proportion for finding the course ADB, fig. 7, viz.

As the distance AD	124	2.09342
is to radius		10 00000
so is the departure AB	86	1.93450
to the sine of the course D	43° 54'	9.84108

so the ship's course is north 33° 45' west, or NWbN¼ west nearly.

Then for the difference of latitude, we have, by rectangular trigonometry, the following analogy, viz.

As radius		10.00000
is to the distance AD	124	2.09342
so is the co-sine of the course	43°, 54'	9.85766
to the diff. of latitude BD	89.35	1.95108

which is equal to 1 degree and 29 min. nearly.

Hence, to find the latitude the ship is in, since both latitudes are north, and the ship sailing from the equator; therefore,

To the latitude sailed from	34°, 24'
add the difference of latitude	1°, 29'
the sum is	35°, 53'

the latitude the ship is in north.

CASE. 6. Course and departure given, to find distance and difference of latitude.

Example. Suppose a ship at sea, in the latitude of 24° 30' south, sails SEbS, till she has made of easting 96 miles: required the distance and difference of latitude made good on that course.

In this case by rectangular trigonometry, and by case 2, we have the following proportion for finding the distance, fig. 8, viz.

As the sine of the course G	33°, 45'	9.74474
is to the departure HM	96	1.98227
so is radius		10 00000
to the distance GM	172 8	2.23753

Then, for the difference of latitude, we have by rectangular trigonometry, the following analogy, viz.

As the tangent of course	33°, 45'	9.82489
is to the departure HM	96	1.98227
so is radius		10.00000
to the difference of lat. GH	143.7	2.15738

equal to 2°, 24' nearly. Consequently, since the latitude the ship sailed from was south, and she sailing still towards the south,

To the latitude sailed from	24°, 30'
add the difference of latitude	2°, 25'
and the sum	26°, 54'

is the latitude she is come to south.

6. When a ship sails on several courses in 24 hours, the reducing all these into one, and thereby finding the course and distance made good upon the whole, is commonly called the resolving of a traverse.

7. At sea they commonly begin each day's reckoning from the noon of that day, and from that time they set down all the different courses and distances sailed by the ship till noon next day upon the log-board; then from these several courses and distances, they compute the difference of latitude, and departure for each course (by case I of Plane Sailing ;) and these together with the courses and distances, are set down in a table, called the Traverse Table, which consists of five columns: in the first of which are placed the courses and distances; in the two next, the differences of latitude belonging to these courses, according as they are north or south: and in the two last are placed the departures belonging to these courses, according as they are east or west. Then they sum up all the northings and all the southings; and taking the difference of these, they know the difference of latitude made good by the ship in the last 24 hours, which will be north or south, according as the sum of the northings, or southings is greatest: the same way, by taking the sum of all the eastings, and likewise of all the westings and subtracting the lesser of these from the greater, the difference will be the departure made good by the ship last 24 hours, which will be east or west according as the sum of the eastings is greater or less than the sum of the westings; then from the difference of latitude and departure made good by the ship last 24 hours, found as above, they find the true course and distance made good upon the whole, by case 4 of Plane Sailing, as also the course and distance to the intended port.

Of Parallel Sailing. Since the parallels of latitude do always decrease the nearer they approach the pole, it is plain a degree on any of them must be less than a degree upon the equator. Now, in order to know the length of a degree on any of them, let PB fig. 9, represent half the earth's axis, PA a quadrant of a meridian, and consequently A a point on the equator, C a point on the meridian, and CD a perpendicular from that point upon the axis, which plainly will be the sine of CP the distance of that point from the pole, or the co-sine of CA its distance from the equator; and CD will be to AB, as the sine of CP, or co-sine of CA, is to the radius. Again, if the quadrant PAB is turned round upon the axis PB, it is plain the point A will describe the circumference of the equator whose radius is AB, and any other point C upon the meridian will describe the circumference of a parallel, whose radius is CD.

Cor. 1. Hence, because the circumference of circles are as their radii, it follows, that the circumference of any parallel is to the circumference of the equator, as the co-sine of its latitude is to radius.

Cor. 2. And since the wholes are as their similar parts, it will be, as the length of a degree on any parallel, is to the length of a degree upon the equator, so is the co-sine of the latitude of that parallel, to radius.

Cor. 3. Hence, as radius, is to the co-sine of any latitude, so are the minutes of difference of longitude between two meridians, or their distance in miles upon the equator, to the distance of these two meridians on the parallel in miles.

Cor. 4. And, as the co-sine of any parallel, is to radius, so is the length of any arch on that parallel, intercepted between two meridians, in miles, to the length of a similiar arch on the equator, or minutes of difference of longitude.

Cor. 5. Also, as the co-sine of any one parallel, is to the co-sine of any other parallel, so is the length of any arch on the first in miles, to the length of the same arch on the other in miles.

Of Mercator's Sailing. Though the meridians do all meet at the pole, and the parallels to the equator do continually decrease, and that in proportion to the co-sines of their latitudes; yet in old sea-charts the meridians were drawn parallel to one another and con-

sequently the parallels of latitude made equal to the equator, and so a degree of longitude on any parallel as large as a degree on the equator; also in these charts the degrees of latitude were still represented, as they are in themselves, equal to each other, and to those of the equator. By these means the degrees of longitude being increased beyond their just proportion, and the more so the nearer they approach the pole, the degrees of latitude at the same time remaining the same, it is evident places must be very erroneously marked down upon these charts with respect to their latitude and longitude, and consequently their bearing from one another very false. To remedy this inconvenience, so as still to keep the meridians parallel, it is plain we must protract, or lengthen, the degrees of latitude in the same proportion as those of longitude are, that so the proportion in easting and westing may be the same with that of southing and northing, and consequently the bearings of places from one another are the same upon the chart as upon the globe itself.

Let ABD, fig. 10, be a quadrant of a meridian, A the pole, D a point on the equator, AC half the axis, B any point upon the meridian, from which draw BF perpendicular to AC, and BG perpendicular to CD; then BG will be the sine, and BF or CG the co-sine, of BD the latitude of the point B; draw DE the tangent and CE the secant of the arch CD. It has been demonstrated, that any arch of a parallel is to the like arch of the equator, as the co-sine of the latitude of that parallel is to radius. Thus any arch, as a minute on the parallel described by the point B, will be to a minute on the equator, as BF or CG is to CD; but since the tringles CGB, CDE, are similar, therefore CG will be to CD as CB is to CE, *i. e.* the co-sine of any parallel is to radius, as radius is to the secant of the latitude of that parallel. But it has been just now shown, that the co-sine of any parallel is to radius, as the length of any arch on that parallel is to the length of the like arch on the equator; therefore the length of any arch on any parallel, is to the length of the like arch on the equator, as radius is to the secant of the latitude of that parallel; and so the length of any arch, on the equator, is longer than the like arch of any parallel, in the same proportion as the secant of the latitude of that parallel is to radius.

But since in this projection the meridians are parallel, and consequently each parallel of latitude equal to the equator, it is plain the length of any arch, as a minute, on any parallel, is increased beyond its just proportion, at such rate as the secant of the latitude of that parallel is greater than radius; and therefore to keep up the proportion of northing and southing to that of easting and westing, upon this chart, as it is upon the globe itself, the length of a minute upon the meridian at any parallel must also be increased beyond its just proportion at the same rate, *i. e.* as the secant of the latitude of that parallel is greater than radius. Thus, to find the length of a minute upon the meridian at the latitude of 75 degrees, since a minute of a meridian is every where equal on the globe and also equal to a minute upon the equator, let it be represented by unity; then making it as radius to the secant of 75 degrees, so is unity to a fourth number, which is 3.864 nearly; and consequently, by whatever line you represent one minute on the equator of this chart, the length of one minute on the enlarged meridian at the latitude of 75 degrees, or the distance between the parallel of 75° 00′ and the parallel of 75° 01′, will be equal to 3 of these lines, and $\frac{864}{1000}$ of one of them. By making the same proportion, it will be found that the length of a minute on the meridian of this chart at the parallel of 60°, or the distance between the parallel of 60° 00′ and that of 60° 01′, is equal to two of these lines. After the same manner, the length of a minute on the enlarged meridian may be found at any latitude; and consequently beginning at the equator, and computing the length of every intermediate minute between that and any parallel, the sum of all these shall be the length of a meridian intercepted between the equator and that parallel; and the distance of each degree and minute of latitude from the equator upon the meridian of this chart, computed in minutes of the equator, forms what is commonly called a table of meridional parts.

If the arch BD, fig. 10, represents the latitude of any point B, then, CD being radius, CE will be the secant of that latitude; but it has been shown above, that radius is to secant of any latitude, as the length of a minute upon the equator is to the length of a minute on the meridian of this chart at that latitude; therefore CD is to CE, as the length of a minute on the equator is to the length of a minute upon the meridian at the latitude of the point B. Consequently, if the radius CD is taken equal [illegible] length of a minute upon the equ[illegible] or the secant of the latitude, will be equal to the length of a minute upon the meridian at that latitude. Therefore, in general, if the length of a minute upon the equator is made radius, the length of a minute upon the enlarged meridian will be every where equal to the secant of the arch contained between it and the equator.

Hence it follows, since the length of every intermediate minute between the equator and any parallel is equal to the secant of the latitude, the radius being equal to a minute upon the equator, the sum of all these lengths, or the distance of that parallel on the enlarged meridian from the equator, will be equal to the sum of all the secants to every minute contained between it and the equator. Consequently, the distance between any two parallels on the same side of the equator, is equal to the difference of the sums of all the secants contained between the equator and each parallel: and the distance between any two parallels on contrary sides of the equator, is equal to the sum of the sums of all the secants contained between the equator and each parallel.

By the tables of meridional parts given by all the writers on this subject, may be constructed the nautical chart, commonly called Mercator's chart. See Maps.

In fig. 11, let A and E represent two places upon Mercator's chart, AC the meridian of A, and CE the parallel of latitude passing through

E; draw AE, and set off upon AC the length AB equal to the number of minutes contained in the difference of latitude between the two places, and taken from the same scale of equal parts the chart was made by, or from the equator, or any graduated parallel of the chart, and through B draw BD parallel to CE meeting AE in D. Then AC will be the enlarged difference of latitude, AB the proper difference of latitude, CE the difference of longitude, BD the departure, AE the enlarged distance, and AD the proper distance, between the two places A and E; also the angle BAD will be the course, and AE the rhumb-line between them.

Of Oblique Sailing. The questions that may be proposed on this head being innumerable, we shall only give one as a specimen.

Coasting along the shore, I saw a cape bear from me NNE: then I stood away NW*b*W 20 miles, and I observed the same cape to bear from me NE*b*E: required the distance of the ship from the cape at each station.

Geometrically. Draw the circle NW SE, figure 21, to represent the compass, NS the meridian, and WE the east and west line, and let C be the place of the ship in her first station; then from C set off upon the NW*b*W line, CA 20 miles, and A will be the place of the ship in her second station.

From C draw the NNE line CB, and from A draw AB parallel to the NE*b*E line CD, which will meet CB in B, the place of the cape, and CB will be the distance of it from the ship in its first station, and AB the distance in the second: to find which,

By Calculation;

In the triangle ABC are given AC, equal to 20 miles; the angle ACB, equal to 78° 45′, the distance between the NNE and NW*b*W lines; also the angle ABC, equal to BCD, equal to 33° 45′, the distance between the NNE and NE*b*E lines; and consequently the angle A, equal to 67° 30′.

Hence, for CB, the distance of the cape from the ship in her first station, it will be, by oblique trigonometry,

S. ABC : AC :: S. BAC · CB.

i. e. As the sine of the angle B	33° 45′	9.74473
is to the distance run AC	20 —	1.30163
so is the sine of BAC -	67 30	9.96562
to CB - - - -	33.26	1.52191

the distance of the cape from the ship at the first station. Then for AB, it will be, by oblique trigonometry,

S. ABC : AC :: S. ACB : AB.

i. e. As the sine of B -	33° 45′	9.74474
is to AC - - -	20 —	1.30103
so is the sine of C -	78 45	9.99157
to AB - - -	35.31	1.54786

the distance of the ship from the cape at her second station.

Before quitting this article, we shall briefly notice Mr. Barlow's admirable discovery of a method of counteracting the local attraction of vessels. For this discovery, Mr. Barlow received the highest reward, viz. that of 500*l.* given by the Board of Longitude. The instrument, as constructed by Mr. Barlow, is thus described. The centre of a small circular plate of iron is placed in the line of the attraction of the ship's iron, and at a proper distance behind and below the pivot of the compass needle; the position of this line having been previously ascertained, an operation now rendered easy by the tables for this purpose prepared by Mr. Barlow, and given with the instrument. When this is done, the needle will remain active and vigorous in the polar regions, and will direct itself in the true magnetic meridian, in whatever part of the world the ship may be. This effect of Mr. Barlow's invention has been established by experiments, between the 61° of south latitude, and the 81° of north latitude, by the accurate observations of Lieutenant Foster, and other naval officers.

With respect to the plate itself, it has hitherto been made double, viz. of two plates screwed together, in such a manner as to combine any strong irregular power of the one with a like weak point in the other; by which means a more uniform attraction is obtained. The plates may vary from 12 to 16 inches in diameter, according to the power of the vessel. They have a hole in their centre, through which is passed a brass socket, with a broad head, and with an exterior screw or nut, by which the two plates and an interposed piece of wood of the same size are compressed strongly together, the board being intended to increase the thickness, without adding much to the weight; and it is found that the two plates thus separated, are more powerful than when in contact. Fig. 13, plate XXXVII, shews the whole combined as in action on ship board.

Navigation Inland. This term properly comprehends whatever relates to the navigation of lakes, rivers, and canals; to the last of these, the following remarks will be confined.

The advantages derived from inland navigation are now so well known, and so universally acknowledged, that nothing need be said on that head. Whatever may be said of the inland navigation of foreign countries, it has been far surpassed by that of Britain; upwards of 2400 miles have been made in England, constituting a congeries of inland navigation not to be equalled in the world; and in the construction of which, difficulties of all kinds have been encountered, and overcome.

This amazing extent of navigation owes its merits to the vigorous and persevering efforts of the Duke of Bridgewater, and others who followed his liberal and spirited example. This great improvement in the conveyance of commodities has arrived at a high degree of perfection, and enables us to transport them even over mountains where it would appear impossible to preserve a communication, or rather a continuity of water-carriage with the subjacent plains. This is effected by the means of locks built of masonry, each of which serves as the conjunction of two different levels. The locks are made only large enough to admit the vessels employed in the business, and have two gates, one at each end. When a vessel should ascend to a superior level, the upper gate is shut, and the vessel being brought within the lock, the lower gate is also closed, and the upper one opened. By this means the water flows in, and the vessel is raised to the intended height. The upper gate is closed as soon as the vessel has passed, but the water in the lock is preserved for the purpose of letting a vessel down, which is done by shutting the upper gate after she is in the lock, and opening the lower one; so that

she is lowered gradually to the next level. The water in all cases is let in or out by means of a small hatch, making its rise and fall very gradual; else the gates would be torn from their hinges by the rush of so large a body, and the vessel would be endangered. We have instances of about twenty locks all in half a mile's distance; but there require very powerful springs to supply a due quantity of water. Sometimes canals are raised above the level of the country; and we have instances where one canal passes over another.

NAUTILUS, in zoology, a genus belonging to the order of vermes testaceæ. The shell consists of one spiral valve, divided into several apartments by partitions. There are 17 species, chiefly distinguished by particularities in their shells. The most remarkable division of the nautili is into the thin and thick-shelled kinds. The first is called nautilus papyraceus; and its shell is indeed no thicker than a piece of paper when out of the water. This species is not at all fastened to its shell; but there is an opinion, as old as the days of Pliny, that this creature creeps out of its shell, and goes on shore to feed. When this species is to sail, it expands two of its arms on high, and between these supports a membrane which it throws out on this occasion; this serves for its sail: and the two other arms it hangs out of its shell, to serve occasionally either as oars or as a steerage; but this last office is generally served by the tail. When the sea is calm, it is common to see numbers of these creatures diverting themselves in this manner; but as soon as a storm rises, or any thing gives them disturbance, they draw in their legs, and take in as much water as makes them specifically heavier than that in which they float; and they sink to the bottom. When they rise again, they void this water by a number of holes, of which their legs are full.

NAVY, the fleet or shipping of a prince or state. The management of the British navy royal, under the Lord High Admiral of Great Britain, is entrusted to principal officers and commissioners of the navy, who hold their places by patent. The principal officers of the navy are four, viz. the Treasurer, whose business it is to receive money out of the exchequer, and to pay all the charges of the navy, by warrant from the principal officers: Comptroller, who attends and comptrols all payment of wages, is to know the rates of stores, to examine and audite all accounts, &c.: Surveyor, who is to know the states of all stores, and see wants supplied, to estimate repairs, charge boatswains, &c. with what stores they receive, and at the end of each voyage to state and audite accounts: Clerk of the Acts, whose business it is to record all orders, contracts, bills, warrants, &c.

The Commissioners of the navy are five: the first executes that part of the Comptroller's duty which relates to the comptrolling the Victualler's accounts; the second, another part of the said Comptroller's duty, relating to the account of the store-keepers of the yard; the third has the direction of the navy at the port of Portsmouth; the fourth has the same at Chatham; and the fifth at Plymouth. There are also other Commissioners at large, the number more or less, according to the exigencies of public affairs; and since the increase of the royal navy, these have several clerks under them, with salaries allowed by the king.

The victualling of the royal navy had formerly been undertaken by contract, but is now managed by Commissioners, who hold their office at Somerset House, Strand.

NAZARITES, among the Jews, persons who either of themselves, or by their parents, were dedicated to the observation of Nazariteship. They were of two sorts, namely, such as were bound to this observance for only a short time, as a week or month; and those who were bound to it all their lives. All that we find peculiar in the latter's way of life is, that they were to abstain from wine and all intoxicating liquors, and never to shave or cut off the hairs of their heads. The first sort of Nazarites were moreover to avoid all defilement; and if they chanced to contract any pollution before the term was expired, they were obliged to begin afresh.

NE ADMITTAS, in law, a writ directed to the bishop, at the suit of one that is patron of a church, where, on a quare impedit, &c. depending, he is doubtful that the bishop will collate his clerk, or admit the other's clerk, during the suit between them.

NEAT, or **Net-weight**, the weight of a commodity alone, clear of the cask, bag, case, or even filth.

NEBULÆ, in astronomy. There are spots in the heavens called nebulæ, some of which consist of clusters of telescopic stars, others appear as luminous spots of different forms. The most considerable is one in the midway between the two stars on the blade of Orion's sword, marked θ by Bayer, discovered in the year 1656 by Huygens; it contains only seven stars, and the other part is a bright spot upon a dark ground, and appears like an opening into brighter regions beyond. Dr. Halley and others have discovered nebulæ in different parts of the heavens. In the "Connoisance des Temps," for 1783 and 1784, there is a catalogue of 103 nebulæ observed by Messier and Mechain. But to Dr. Herschel we are indebted for catalogues of 2000 nebulæ, and clusters of stars, which he himself has discovered. Some of them form a round compact system, others are more irregular, of various forms, and some are long and narrow. He supposes, that the milky way is the nebulæ of which our sun is one of its component parts.

Dr. Herschel has also discovered other phenomena in the heavens, which he calls *nebulous stars;* that is, stars surrounded with a faint luminous atmosphere of large extent. Those which have been thus styled by other astronomers, he says, ought not to have been so called, being either mere clusters of stars plainly to be distinguished by his large telescopes, or such nebulous appearances as might be occasioned by a multitude of stars at a vast distance. The milky way consists entirely of stars.

NEBULY, or **Nebulee**, in heraldry, is when a coat is charged with several little figures, in form of words, running within one another, or when the outline of a bordure, ordinary, &c. is indented or waved.

NECESSITY. The law charges no man with default where the act is compulsory, and not voluntary, and where there are not a con-

rent and election; and therefore if either there is an impossibility for a man to do otherwise, or so great a perturbation of the judgment and reason as in presumption of law man's nature cannot overcome, such necessity carries a privilege in itself. Necessity is of three sorts; necessity of conservation of life, necessity of obedience, and necessity of the act of God, or of a stranger.

NECESSITY *Philosophical.* This subject, which stands in direct opposition to the freedom of the human will, has occasioned much discussion among the learned. The advocates of philosophical necessity affirm that the volitions and actions of intelligent agents are produced by causes equally deciding and resistless as those which are admitted to actuate the material system of the universe. See WILL.

NECK, is that slender part situated between the head and trunk of the body. See ANATOMY.

NECTARINE. See PERSICA.

NECTARIUM, in botany, according to Linnæus, is a part of the corolla, appropriated for containing honey, that oozes from the plant, and is the principal food of bees and other insects.

NEEDLE, a very common little instrument made of steel, pointed at one end, and pierced at the other, used in sewing. The sizes are from number 1, the largest, to number 25, the smallest. In the manufacture of needles, German and Hungarian steel are of most repute. In making them, the steel is passed through a coal fire, and under a hammer, to bring it out into a cylindrical form. This done, it is drawn through the holes of a wire-drawing-iron, successively, till it has acquired the degree of fineness required. The wire is then cut into pieces of the length intended. These pieces are flatted at one end on the anvil, in order to form the head and eye: they are then put into the fire to soften them further, and thence taken out and pierced at each extreme of the flat part of the anvil, with a puncheon of well tempered steel, and laid on a leaden block to bring out, with another puncheon, the little piece of steel remaining in the eye. The corners are then filed off the square of the heads, and a little cavity filed on each side of the flat of the head; the point is then formed with a file, and the whole filed over; they are then laid to heat red hot in a charcoal fire, and when taken out hence, are thrown out into a bason of cold water to harden. When thus hardened, they are laid in an iron shovel on a fire, more or less brisk in proportion to the thickness of the needles, taking care to move them from time to time. This serves to temper them, and take off their brittleness. They are then straightened one after another with the hammer. The next process is the polishing them. To do this, they take twelve or fifteen thousand needles, and range them in little heaps against each other on a piece of new buckram sprinkled with emery dust. The needles thus disposed, emery dust is thrown over them, which is again sprinkled with oil of olives; at last the whole is made up into a roll, well bound at both ends. This roll is then laid on a polishing-table, and over it a thick plank loaded with stone, which two men work backwards and forwards a day and a half, or two days, successively; by which means the roll, thus continually agitated by the weight and motion of the plank over it, the needles within side being rubbed against each other with oil and emery, are insensibly polished. They are then taken out, and the filth washed off them with hot water and soap: they are then wiped in hot bran, a little moistened, placed with the needles in a round box, suspended in the air by a cord, which is kept stirring till the bran and needles be dry. The points are then all turned the same way, and smoothed with an emery stone turned with a wheel. They are then done up into packets of two hundred and fifty each.

NEEDLE, *magnetical,* in navigation, a needle touched with a loadstone, and sustained on a pivot or centre: on which playing at liberty, it directs itself to certain points in or under the horizon. The magnetical needle is of two kinds, viz. horizontal and inclinatory.

Horizontal needles are those equally balanced on each side the pivot that sustains them, and which playing horizontally with their two extremes, point out the north and south points of the horizon.

Inclinatory or dipping needle, a magnetical needle, so hung, as that, instead of playing horizontally and pointing out north and south, one end dips or inclines to the horizon, and the other points to a certain degree of elevation above it. See COMPASS and MAGNETISM.

NEGATIVE, in general, something that implies a negation. Thus we say, negative quantities, negative signs, negative powers, &c. See ALGEBRA.

NEGRO, a name given to a variety of the human species, who are entirely black, and are found in the torrid zone, especially in that part of Africa which lies between the tropics.

NEPA, *water-scorpion,* a genus of insects of the order hemiptera. Snout inflected; antennæ short; wings four, folding cross-wise, coriaceous on the upper part; fore legs cheliform; the other four formed for walking. There are 14 species, inhabiting stagnant waters, and preying on the smaller water insects, &c.

NEPER's RODS, or BONES, an instrument invented by J. Neper, baron of Merchiston, in Scotland, whereby the multiplication and division of large numbers are much facilitated.

NEPER'S ROD, *the construction of.* Suppose the common table of multiplication to be made upon a plate of metal, ivory, or paste-board, and then conceive the several columns (standing downwards from the digits on the head) to be cut asunder; and these are what we call Neper's rods for multiplication. But then there must be a good number of each, for as many times as any figure is in the multiplicand, so many rods of that species (i. e. with that figure on the top of it) must we have; though six rods of each species will be sufficient for any example in common affairs; there must be also as many rods of 0's.

But before we explain the way of using these rods, there is another thing to be known, viz. that the figures on every rod are written in an order different from that in the table. Thus, the little square space or division in which the several products of every column are written, is divided into two parts by a line across from the upper angle on the right to the lower on the left; and if the product is

a digit, it is set in the lower division; if it has two places, the first is set in the lower, and the second in the upper division; but the spaces on the top are not divided. Also there is a rod of digits, not divided, which is called the index-rod; and of this we need but one single rod.

Multiplication by Neper's Rods.—Lay down the index-rod; then on the right of it set a rod whose top is the figure in the highest place of the multiplicand; next to this again, set the rod whose top is the next figure of the multiplicand; and so on in order to the first figure. Then is your multiplicand tabulated for all the nine digits; for in the same line of squares standing against every figure of the index-rod, you have the product of that figure, and therefore you have no more to do but to transfer the products, and sum them. But in taking out these products from the rods, the order in which the figures stand obliges you to a very easy and small addition: thus, begin to take out the figure in the lower part, or unit's place, of the square of the first rod on the right: add the figure in the upper part of this rod to that in the lower part of the next, and so on, which may be done as fast as you can look on them. To make this practice as clear as possible, take the following example.

Example.—To multiply 4768 by 185.

Having set the rods together for the number 4768, against 5 in the index I find this number,

by adding according to the rule -	23840
Against 8 this number - -	38144
Against 3 this number - -	14304
Total product - - - -	1835680

Division by Neper's Rods.—Tabulate your divisor; then you have it multiplied by all the digits, out of which you may choose such convenient divisors as will be next less to the figures in the dividend, and write the index answering in the quotient, and so continually, till the work is done. Thus 2,179,788, divided by 6,123, gives in the quotient 356.

Having tabulated the divisor, 6,123, you see that 6,123 cannot be had in 2,179; therefore take five places, and on the rods find a number that is equal, or next less to 21,797, which is 18,369: that is, three times the divisor, wherefore set 3 in the quotient, and subtract 18,369 from the figures above, and there will remain 3,428; to which add 8, the next figure of the dividend, and seek again on the rods for it, or the next less, which you will find to be five times; therefore set 5 in the quotient, and subtract 3,0615 from 34.228, and there will remain 3,673, to which add 8, the last figure in the dividend, and finding it to be just six times the divisor, set 6 in the quotient.

NEPETA, Catmint, or Nep, a genus of the gymnospermia order, in the didynamia class of plants; and in the natural method ranking under the 42d order, verticillatæ.—There are 20 species; the most remarkable is the *cataria*, common nep, or cat-mint. This is a native of many parts of Britain, growing about hedges, and in waste places. The plant has a bitter taste, and strong smell, not unlike pennyroyal.

NEPHRITE, in mineralogy, a species of the Talc genus; it is also called *jade*, or *jade-stone*. It was formerly celebrated for its medical virtues. It is of a dark leek-green colour, verging to blue. It occurs massive in detached rounded pieces. Nephrite is found in Egypt, China, America, the islands in the Pacific Ocean, and in the Siberian mountains sometimes adhering to rocks, and sometimes in detached round pieces. It is highly prized by the Hindoos and Chinese, by whom it is made into talismans and idols, and by the Turks, who form it into sword and dagger handles.

NEPHRITIC, something that relates to the kidneys.

NEREIS, in natural history, a genus of the vermes mollusca class and order. Body long, creeping, with numerous lateral peduncles or feet on each side; feelers simple; two or four eyes. There are about 30 species, in separate divisions. *N. noctiluca*, body blue-green, with 23 segments, hardly visible to the naked eye. These are found in most seas, and are highly phosphorous, giving a lucid splendour to the waves in the evening.

NERITA, a genus of vermes testacea: the generic character is; animal a limax; shell univalve, spiral, gibbous, flattish at bottom; aperture semiorbicular or semilunar; pillar-lip transversely truncate, flattish. There are about 80 species of this genus.

NERVES. See Anatomy.

NET, a device for catching fish and fowl. The making the nets is very easy, and what every true sportsman ought to be able to do for himself. All the necessary tools are wooden needles, of which there should be several of different sizes, some round and others flat: a pair of round-pointed and flat scissars, and a wheel to wind off the thread. The packthread is to be of different strength and thickness, according to the sort of birds to be taken; and the general size of the meshes, if not for very small birds, is two inches from point to point. The nets should neither be made too deep nor too long, for they are then difficult to manage; and they must be verged on each side with twisted thread.

NETTINGS, in a ship, a sort of grates made of small ropes, seized together with rope-yarn or twine, and fixed on the quarters and in the tops; they are sometimes stretched upon the ledges from the waste-trees to the roof-trees, from the top of the forecastle to the poop; and sometimes are laid in the waste of a ship to serve instead of gratings.

NETTLE. See Urtica.

NEUTRALIZATION. When acid and alkaline matter are combined in such proportions that the compound does not change the colour of litmus or violets, they are said to be neutralized.

NEWTONIAN PHILOSOPHY, the doctrine of the universe, or the properties, laws, affections, actions, forces motions, &c. of bodies, both celestial and terrestrial, as delivered by Newton.

The chief parts of the Newtonian philosophy, as delivered by the author, except his Optical Discoveries, &c. are contained in his Principia, or Mathematical Principles of Natural Philosophy. He founds his system on the following definitions.

1. Quantity of matter is the measure of the same, arising from its density and bulk con-

jointly. Thus, air of a double density, in the same space, is double in quantity; in a double space, is quadruple in quantity; in a triple space, is sextuple in quantity, &c.

2. Quantity of motion is the measure of the same, arising from the velocity and quantity of matter conjunctly. This is evident, because the motion of the whole is the motion of all its parts: and therefore in a body double in quantity, with equal velocity, the motion is double, &c.

3. The *vis insita, vis inertiæ*, or innate force of matter, is a power of resisting, by which every body, as much as in it lies, endeavours to persevere in its present state, whether it is of rest, or moving uniformly forward in a right line.

4. An impressed force is an action exerted upon a body, in order to change its state, whether of rest or motion. This force consists in the action only; and remains no longer in the body when the action is over.

5. A centripetal force is that by which bodies are drawn, impelled, or any way tend, towards a point, as to a centre. This may be considered of three kinds, absolute, accelerative, and motive.

6. The absolute quantity of a centripetal force is a measure of the same, proportional to the efficacy of the cause that urges it to the centre.

7. The accelerative quantity of a centripetal force, is the measure of the same, proportional to the velocity which it generates in a given time.

8. The motive quantity of a centripetal force, is a measure of the same, proportional to the motion which it generates in a given time. This is always known by the quantity of force equal and contrary to it, that is just sufficient to hinder the descent of the body.

After these definitions, follow certain scholia, treating of the nature and distinctions of time, space, place, and motion, absolute, relative, apparent, true, real, &c. After which, the author proposes to shew how we are to collect the true motions from their causes, effects, and apparent differences; and vice versa, how, from the motions, either true or apparent, we may come to the knowledge of their causes and effects. In order to this, he lays down the following axioms or laws of motion.

1st law. Every body perseveres in its state of rest, or of uniform motion in a right line, unless it is compelled to change that state by forces impressed upon it.

2d law. The alteration of motion is always proportional to the motive force impressed, and is made in the direction of the right line in which that force is impressed.

3d law. To every action there is always opposed an equal re-action; or the mutual actions of two bodies upon each other, are always equal, and directed to contrary parts. Thus, whatever draws or presses another, is as much drawn or pressed by that other.

From this axiom, or law, Newton deduces the following corollaries:

1. A body by two forces conjoined will describe the diagonal of a parallelogram, in the same time that it would describe the sides by those forces apart.

2. Hence is explained the composition of any one direct force out of any two oblique ones, viz. by making the two oblique forces the sides of a parallelogram, and the diagonal the direct one.

3. The quantity of motion, which is collected by taking the sum of the motions directed towards the same parts, and the difference of those that are directed to contrary parts, suffers no change from the action of bodies among themselves; because the motion which one body loses is communicated to another.

4. The common centre of gravity of two or more bodies does not alter its state of motion or rest by the actions of the bodies among themselves; and therefore the common centre of gravity of all bodies, acting upon each other, (excluding external actions and impediments) is either at rest, or moves uniformly in a right line.

5. The motions of bodies included in a given space are the same among themselves, whether that space is at rest, or moves uniformly forward in a right line without any circular motion. The truth of this is evident from the experiment of a ship; where all motions are just the same, whether the ship is at rest, or proceeds uniformly forward in a straight line.

6. If bodies, any how moved among themselves, are urged in the direction of parallel lines by equal accelerative forces, they will all continue to move among themselves, after the same manner as if they had not been urged by such forces.

The mathematical part of the Newtonian Philosophy depends chiefly on the following lemmas, especially the first, containing the doctrine of prime and ultimate ratios.

Lem. 1. Quantities, and the ratios of quantities, which in any finite time converge continually to equality, and before the end of that time approach nearer the one to the other than by any given difference, become ultimately equal.

Lem. 2 shews, that in a space bounded by two right lines and a curve, if an infinite number of parallelograms are inscribed, all of equal breadth; then the ultimate ratio of the curve space, and the sum of the parallelograms, will be a ratio of equality.

Lem. 3 shews that the same thing is true when the breadths of the parallelograms are unequal.

In the succeeding lemmas it is shewn, in like manner, that the ultimate ratios of the sine, chord, and tangent, of arcs infinitely diminished, are ratios of equality; and therefore that in all our reasonings about these, we may safely use the one for the other: that the ultimate form of evanescent triangles, made by the arc, chord, or tangent, is that of similitude, and their ultimate ratio is that of equality; and hence, in reasonings about ultimate ratios, these triangles may safely be used one for another, whether they are made with the sine, the arc, or the tangent. He then demonstrates some properties of the ordinates of curvilinear figures; and shews that the spaces which a body describes by any finite force urging it, whether that force is determined and immutable, or continually varied, are to each other, in the very beginning of the motion, in the duplicate ratio of

the forces; and lastly, having added some demonstrations concerning the evanescence of angles of contact, he proceeds to lay down the mathematical part of his system, which depends on the following theorems.

Theor. 1. The areas which revolving bodies describe by radii drawn to an immoveable centre of force, lie in the same immoveable planes, and are proportional to the times in which they are described.

Theor. 2. Every body that moves in any curve line described in a plane, and by a radius drawn to a point either immoveable or moving forward with an uniform rectilinear motion, describes about that point areas proportional to the times, is urged by a centripetal force directed to that point.

Theor. 3. Every body that by a radius drawn to the centre of another body, any how moved, describes areas about that centre proportional to the times, is urged by a force compounded of the centripetal forces tending to that other body, and of the whole accelerative force by which that other body is impelled.

Theor. 4. The centripetal forces of bodies which by equal motions describe different circles, tend to the centres of the same circles; and are one to the other as the squares of the arcs described in equal times, applied to the radii of circles.

On these and such like principles depends the Newtonian mathematical philosophy. The author farther shews how to find the centre to which the forces impelling any body are directed, having the velocity of the body given; and finds that the centrifugal force is always as the versed sine of the nascent arc directly, and as the square of the time inversely: or directly as the square of the velocity, and inversely as the chord of the nascent arc. From these premises, he deduces the method of finding the centripetal force directed to any given point when the body revolves in a circle; and this, whether the central point is near hand, or at immense distance; so that all the lines drawn from it may be taken for parallels. And he shews the same thing with regard to bodies revolving in spirals, ellipses, hyberbolas, or parabolas.

He shews, also, having the figures of the orbits given, how to find the velocities and moving powers; and indeed resolves the most difficult problems relating to the celestial bodies with a surprising degree of mathematical skill.

In the second book, Newton treats of the properties and motion of fluids, and their powers of resistance, with the motion of bodies through such resisting mediums, those resistances being in the ratio of any powers of the velocities; and the motions being either made in right lines or curves, or vibrating like pendulums.

The third book is occupied in demonstrating the frame of the system of the world; and the phenomena first considered are the following.

1. That the satellites of Jupiter, by radii drawn to his centre, describe areas proportional to the times of description; and that their periodic times, the fixed stars being at rest, are in the sesquiplicate ratio of their distances from that centre. 2. The same thing is likewise observed of the phenomena of Saturn. 3. The five primary planets, Mercury, Venus, Mars, Jupiter, Saturn with their several orbits, encompass the sun. 4. The fixed stars being supposed at rest, the periodic times of the said five primary planets, and of the earth, about the sun, are in the sesquiplicate proportion of their mean distances from the sun. 5. The primary planets, by radii drawn to the earth, describe areas no ways proportional to the times; but the areas which they describe by radii drawn to the sun are proportional to the times of description. 6. The moon, by a radius drawn to the centre of the earth, describes an area proportional to the time of description. All which phenomena are clearly evinced by astronomical observations. The mathematical demonstrations are next applied by Newton in the following propositions.

Prop. 1. The forces by which the satellites of Jupiter are continually drawn off from rectilinear motions, and retained in their proper orbits, tend to the centre of that planet, and are reciprocally as the squares of the distances of those satellites from that centre.

Prop. 2. The same thing is true of the primary planets, with respect to the sun's centre.

Prop. 3. The same thing is also true of the moon, in respect of the earth's centre.

Prop. 4. The moon gravitates towards the earth; and by the force of gravity is continually drawn off from a rectilinear motion, and retained in her orbit.

Prop. 5. The same thing is true of all the other planets, both primary and secondary, each with respect to the centre of its motion.

Prop. 6. All bodies gravitate towards every planet; and the weights of bodies towards any one and the same planet, at equal distances from its centre, are proportional to the quantities of matter they contain.

Prop. 7. There is a power of gravity tending to all bodies proportional to the several quantities of matter which they contain.

Prop. 8. In two spheres mutually gravitating each towards the other, if the matter in places on all sides, round about, and equidistant from the centres, is similar, the weight of either sphere towards the other, will be reciprocally as the square of the distance between their centres. Hence are compared together the weights of bodies towards different planets; hence also are discovered the quantities of matter in the several planets; and hence likewise are found the densities from those planets.

Prop. 9. The force of gravity, in parts downwards from the surface of the planets towards their centres, decreases nearly in the proportion of the distances from those centres.

These, and many other proportions and corollaries, are proved or illustrated by a great variety of experiments, in all the great points of physical astronomy.

NICKLE. See Chemistry.

NICOTIANA. See Tobacco.

NICTITATING *membrane,* in comparative anatomy, a thin membrane, chiefly found in the bird and fish-kind, which covers the eyes of these animals, sheltering them

from the dust or from too much light; yet is so thin and pellucid, that they can see pretty well through it.

NIDUS, among naturalists, signifies a nest, or proper repository for the eggs of birds, insects, &c. wherein the young of these animals are hatched and nursed.

NIGHT, that part of the natural day during which the sun is underneath the horizon; or that space wherein it is dusky. Night was originally divided by the Hebrews, and other eastern nations, into three parts, or watchings. The Romans, and afterwards the Jews from them, divided the night into four parts, or watches, the first of which began at sun-set and lasted till nine at night, according to our way of reckoning; the second lasted till midnight; the third till three in the morning; and the fourth ended at sun-rise. The ancient Gauls and Germans divided their time not by days but by nights; and the people of Iceland and the Arabs do the same at this day. The like is also observed of our Saxon ancestors.

NIGHT-MARE. See MEDICINE.

NIGHTINGALE. See MOTACILLA.

NIHIL DICIT, a failure in the defendant to put in an answer to the plaintiff's declaration, &c. by the day assigned for that purpose, by which omission judgment of course is had against him.

NIMBUS, in antiquity, a circle observed on certain medals, or round the head of some emperors, answering to the circles of light drawn around the images of saints.

NINTH, in music, an interval containing an octave and a tone; also a name given to the chord consisting of a common chord with the eighth advanced one note.

NIPA, a genus of the natural order of palms. The male has a spathe; the corolla is six-petalled. The female has a spathe; corolla none; drupes angular. There is one species, a native of the E. Indies. The leaves are used in making mats.

NIPPLES, in anatomy. See MAMMARY GLAND.

NISI PRIUS, in law, a commission directed to the judges of assize, empowering them to try all questions of fact issuing out of the courts at Westminster that are then ready for trial by jury. The original of which name is this: all causes commenced in the courts of Westminster-hall are, by course of the courts, appointed to be tried on a day fixed in some Easter or Michaelmas term, by a jury returned from the county wherein the cause of action arises; but with this proviso, nisi prius justiciarii ad assisas capiendas venerint: that is, unless before the day prefixed, the judges of assize come into the county in question, which they always do in the vacation preceding each Eastern and Michaelmas term, and there try the cause. And then upon the return of the verdict given by the jury to the court above, the judges there give judgment for the party for whom the verdict is found.

NITRATES, are salts formed of nitric acid, with the salifiable bases.

NITRE, commonly known by the name of *saltpetre*, is found ready formed in the East Indies, in Spain, in the kingdom of Naples, and elsewhere, in considerable quantities; but nitrate of lime is still more abundant. For the greater part of the nitre made use of is produced by a combination of circumstances which tend to compose and condense nitric acid. This acid appears to be produced in all situations, where animal matters are completely decomposed with access of air, and of proper substances with which it can readily combine. Grounds frequently trodden by cattle, and impregnated with their excrements, or the walls of inhabited places, where putrid animal vapours abound, such as slaughter-houses, drains, or the like, afford nitre by long exposure to the air.

Artificial nitre beds are made by an attention to the circumstances in which this salt is produced by nature. Dry ditches are dug, and covered with sheds, open at the sides, to keep off the rain: these are filled with animal substances—such as dung, or other excrements, with the remains of vegetables, and old mortar, or other loose calcareous earth; this substance being found to be the best and most convenient receptacle for the acid to combine with. Occasional watering, and turning up from time to time, are necessary to accelerate the process, and increase the surfaces to which the air may apply; but too much moisture is hurtful.

If the beds contain much vegetable matter, a considerable proportion of the nitrous salt will be common saltpetre; but if otherwise, the acid will, for the most part, be combined with the calcareous earth. It consists of 6.75 acid + 6 potash.

To extract the saltpetre from the mass of earthy matter, a number of large casks are prepared with a cock at the bottom of each, and a quantity of straw within, to prevent its being stopped up. Into these the matter is put, together with wood-ashes, either strewed at top, or added during the filling. Boiling water is then poured on, and suffered to stand for sometime; after which it is drawn off, and other water added in the same manner, as long as any saline matter can be thus extracted.

The crystals of nitre are usually of the form of six-sided flattened prisms, with diedral summits. Its taste is penetrating; but the cold produced by placing the salt to dissolve in the mouth, is such as to predominate over the real taste at first. Seven parts of water dissolve two of nitre, at the temperature of sixty degrees; but boiling water dissolves its own weight. 100 parts of alcohol, at a heat of 176°, dissolve only 2.9.

On being exposed to a gentle heat, nitre fuses; and in this state being poured into moulds, so as to form little round cakes, or balls, it is called *sal prunella*, or *crystal mineral*.

This salt powerfully promotes the combustion of inflammable substances. Two or three parts mixed with one of charcoal, and set on fire, burn rapidly; azote and carbonic acid gas are given off, and a small portion of the latter is retained by the alkaline residuum, which was formerly called *clyssus of nitre*. Three parts of nitre, two of subcarbonate of potash, and one of sulphur, mixed together in a warm mortar, form the *fulminating power:* a small quantity of which, laid on a fire shovel, and held over the fire

till it begins to melt, explodes with a loud sharp noise. Mixed with sulphur and charcoal it forms *gunpowder*

The uses of nitre are various. Besides those already indicated, it enters into the composition of fluxes, and is extensively employed in metallurgy; it serves to promote the combustion of sulphur in fabricating its acid; it is used in the art of dyeing; it is added to common salt for preserving meat, to which it gives a red hue; it is an ingredient in some frigorific mixtures; and it is prescribed in medicine, as cooling, febrifugal, and diuretic; and some have recommended it mixed with vinegar, as a very powerful remedy for the sea scurvy.

NITRIC-ACID. The two principal constituent parts of our atmosphere, when in certain proportions, are capable, under particular circumstances, of combining chemically into one of the most powerful acids, the nitric. If these gasses be mixed in a proper proportion in a glass tube about a line in diameter, over mercury, and a series of electric shocks be passed through them for some hours, they will form nitric acid; or if a solution of potash be present with them, nitrate of potash will be obtained. The constitution of this acid may be further proved, analytically, by driving it through a red-hot porcelain tube, as thus it will be decomposed into oxygen and nitrogen gases. For all practical purposes, however, the nitric acid is obtained from nitrate of potash, from which it is expelled by sulphuric acid.

The nitric acid is of considerable use in the arts. It is employed for etching on copper; as a solvent of tin to form with that metal a mordant for some of the finest dyes; in metallurgy and assaying; in various chemical processes, on account of the facility with which it parts with oxygen and dissolves metals; in medicine as a tonic, and as a substitute for mercurial preparations in siphylis and affections of the liver, as also in form of vapour to destroy contagion. For the purposes of the arts it is commonly used in a diluted state, and contaminated with the sulphuric and muriatic acids, by the name of *aquafortis.* This is generally prepared by mixing common nitre with an equal weight of sulphate of iron, and half its weight of the same sulphate calcined, and distilling the mixture; or by mixing nitre with twice its weight of dry powdered clay, and distilling in a reverberatory furnace. Two kinds are found in the shops, one called *double aquafortis,* which is about half the strength of nitric acid; the other simply *aquafortis,* which is half the strength of the double.

A compound made by mixing two parts of the nitric acid with one of muriatic, known formerly by the name of *aqua regia*, and now by that of *nitro-muriatic acid,* has the property of dissolving gold and platina. On mixing the two acids, heat is given out, an effervescence takes place, and the mixture acquires an orange colour. *Aqua regia* does not oxidize gold and platina. It merely causes their combination with chlorine.

With the different bases the nitric acid forms nitrates. The nitrate of barytes, when perfectly pure, is in regular octaedral crystals, though it is sometimes obtained in small shining scales. It may be prepared by uniting barytes directly with nitric acid, or by decomposing the carbonate or sulphuret of barytes with this acid. Nitrate of strontian may be obtained in the same manner as that of barytes, with which it agrees in the shape of its crystals, and most of its properties. Applied to the wick of a candle, or added to burning alcohol, it gives a deep red colour to the flame. On this account it may be useful, perhaps, in the art of pyrotechny. Nitrate of lime, the *calcareous nitre* of older writers, abounds in the mortar of old buildings, particularly those that have been much exposed to animal effluvia, or processes in which azote is set free The nitrate of ammonia possesses the property of exploding, and being totally decomposed, at the temperature of 600°; whence it acquired the name of *nitrum flammans.* The readiest mode of preparing it is by adding carbonate of ammonia to dilute nitric acid till saturation takes place.

NITROGEN, called also AZOTE, is an important elementary or undecomposed principle. As it constitutes four-fifths of the volume of atmospheric air, the readiest mode of procuring azote is to abstract its oxygenous associate, by the combustion of phosphorus or hydrogen. It may also be obtained from animal matter, subjected in a glass retort to the action of nitric acid, diluted with 8 or 10 times its weight of water.

Azote possesses all the physical properties of air. It extinguishes flame and animal life. It is absorbable by about 100 volumes of water. Its spec. gravity is 0.9722. 100 cubic inches weight 29.65 grains. It has neither taste nor smell. It unites with oxygen in four proportions, forming four important compounds. These are,

1 Protoxide of azote, or nitrous oxide.

2. Deutoxide of azote, nitrous gas, or nitric oxide.

3. Nitrous acid.

4. Nitric acid.

Nitrous oxide or *protoxide of azote,* was discovered by Dr. Priestley in 1772, but was first accurately investigated by Sir H. Davy in 1799. The best mode of procuring it, is to expose the salt called nitrate of ammonia, to the flame of an Argand lamp, in a glass retort. When the temperature reaches 400° F. a whitish cloud will begin to project itself into the neck of the retort, accompanied by the copious evolution of gas, which must be collected over mercury for accurate researches, but for common experiments may be received over water. It has all the physical properties of air. It has a sweet taste a faint agreeable odour, and is condensable by about its own volume of water, previously deprived of its atmospheric air. This property enables us to determine the purity of nitrous oxide. A taper plunged into this gas burns with great brilliancy; the flame being surrounded with a bluish halo. But phosphorus may be melted and sublimed in it, without taking fire. When this combustible is introduced into it, in a state of vivid combustion, the brilliancy of the flame is greatly increased. Sulphur and most other combustible bodies require a higher degree of heat for their combustion in it, than in either oxygen or common air. This may be

intimately combined with azote. Its sp. grav. is 1.5277. 100 cubic inches weigh 46.6 gr. It is respirable, but not fitted to support life. Sir H. Davy first shewed, that by breathing a few quarts of it, contained in a silk bag, for two or three minutes, effects analogous to those occasioned by drinking fermented liquors were produced. Individuals, who differ in temperament, are, however, as we might expect, differently affected.

Among others who have tried the effect of this gas on the nervous system, we have the name of Robert Southey. We are not acquainted with the exact time at which the poet inhaled the pleasing draught, but the effect produced was rather ominous, viz—*Giddiness*, the effect of *elevation*, and the fear of *falling*. The following is his own account of the matter:

Mr. Robert Southey could not distinguish between the first effects and an apprehension of which he was unable to divest himself. His first definite sensations were, a fulness and dizziness in the head, such as to induce a fear of falling. This was succeeded by a laugh which was involuntary, but highly pleasurable, accompanied with a peculiar thrilling in the extremities; a sensation perfectly new and delightful. For many hours after this experiment, he imagined that his taste and smell were more acute, and is certain that he felt unusually strong, and cheerful. In a second experiment, he felt pleasure still superior, and has once poetically remarked, that he supposes the atmosphere of the highest of all possible heavens to be composed of this gas.

This gas is frequently given by public lecturers to some of their audience for inhalation, in order to afford amusement to the company; but much caution ought to be observed on this head, as it has been known to prove fatal, where there was a tendency of blood to the head.

NOBILITY, a quality that ennables, and raises a person possessed of it above the rank of a commoner.

The civil state of England consists of the nobility and commonalty. The nobility are all those who are above the degree of knight, under which term is included that of a baronet; namely, dukes, marquises, earls, viscounts and barons.

NOBLE, a money of account containing six shillings and eight-pence. The noble was anciently a real coin struck in the reign of Edward III. and then called the penny of gold; but it was afterwards called a rose noble, from its being stamped with a rose.

NOCTURNAL, something relating to the night, in contradistinction to diurnal.

NOCTURNAL *arch*, in astronomy, the arch of a circle described by the sun, or a star, in the night.

NOCTURNAL, *semi, arch of the sun*, is that portion of a circle he passes over between the lower part of our meridian and the point of the horizon, wherein he arises; or between the point of the horizon wherein he sets, and the lower part of our meridian.

NOCTURNAL, NOCTURLABIUM, an instrument chiefly used at sea, to take the altitude or depression of some stars about the pole, in order to find the latitude, and hour of the night.

Some nocturnals are hemispheres, or planispheres on the plane of the equinoctial. Those commonly in use among seamen are two; the one adapted to the polar star, and the first of the guards of the little bear; the other to the pole-star, and the pointers of the great bear.

This instrument consists of two circular plates applied to each other. The greater, which has a handle to hold the instrument, is about two inches and a half diameter, and is divided into twelve parts, agreeing to the twelve months, and each month subdivided into every fifth day; and so as that the middle of the handle corresponds to that day of the year wherein the star here regarded has the same right ascension with the sun. If the instrument be fitted for two stars, the handle is made moveable. The upper left circle is divided into twenty-four equal parts for the twenty-four hours of the day, and each hour sub-divided into quarters. These twenty-four hours are noted by twenty-four teeth to be told in the night. Those at the hours twelve, are distinguished by their length. In the centre of the two circular plates is adjusted a long index, moveable upon the upper plate. And the three pieces, *viz.* the two circles and index, are joined by a rivet which is pierced through the centre with a hole, through which the star is to be observed.

"To use the Nocturnal," turn the upper plate till the long tooth, marked twelve, be against the day of the month on the under plate: then, bringing the instrument near the eye, suspend it by the handle with the plane nearly parallel to the equinoctial; and viewing the pole-star through the hole of the centre, turn the index about till, by the edge coming from the centre, you see the bright star or guard of the little bear (if the instrument be fitted to that star:) then that tooth of the upper circle, under the edge of the index, is at the hour of the night on the edge of the hour circle: which may be known without a light, by counting the teeth from the longest, which is for the hour twelve.

NODE, in surgery, a tumor arising on the bones, and usually proceeding from some venereal cause.

NODES, in astronomy, the two points wherein the orbit of a planet intersects the ecliptic, whereof the node, where the planet ascends northwards, above the plane of the ecliptic, is called the ascending node, the northward node, and the head of the Dragon, and is marked thus ☊; the other node, where the plane descends to the south, is called the descending node, the southward node, or the Dragon's tail, marked thus ☋.

The line wherein the two circles intersect, is called the line of nodes. It appears from observation, that the line of the nodes of all the planets constantly changes its place, and shifts its situation from east to west, contrary to the order of the signs; and that the line of the Moon's nodes, by a retrograde motion, finishes its circulation in the compass of nineteen years; after which time, either of the nodes having receded from any point of the ecliptic, returns to the same again; and when the

Moon is in the node, she is also seen in the ecliptic.

NO-MAN'S-LAND, a space in midships, between the after-part of the belfry and the forepart of a boat, when she is stowed upon the booms, as in a deep waisted vessel.

NOMENCLATURE, a catalogue of several of the more usual words in any language, with their significations, compiled in order to facilitate the use of such words, to those who are to learn the tongue: such are our Latin, Greek, French, &c. nomenclatures.

NOMINATIVE, in grammar, the first case of nouns which are declinable.

NONAGISMAL, in astronomy, the 90th degree of the ecliptic, reckoned from the eastern term, or point. The altitude of the nonagesimal is equal to the angle of the east, and, if continued, passes through the poles of the ecliptic; whence the altitude of the nonagesimal at a given time, under a given elevation of the pole, is easily found.

NON-APPEARANCE, a default in not appearing in a court of judicature. Attorneys subscribing warrants for appearing in court are liable to attachment and fine for non-appearance. If a defendant does not appear and find bail upon a scire facias and rule given, judgment may be had against him.

NON-COMPOS-MENTIS, in law, is used to denote a person's not being of sound memory and understanding. Of these persons there are four different kinds: an idiot, a madman, a lunatic, who has lucid intervals, and a drunkard who deprives himself of reason by his own act and deed.

NONES, *nonæ*, in the Roman calendar, the fifth day of the months January, February, April, June, August, September, November, and December; and the seventh of March, July, and October. March, May, July, and October, had six days in their nones; because these alone, in the ancient constitution of the year by Numa, had 31 days each, the rest having only 29, and February 30; but when Cæsar reformed the year, and made other months containing 31 days, he did not allot them six days of nones.

NONIUS. See Vernier.

NONSUIT, in law, is where a person has commenced an action, and at the trial fails in his evidence to support it, or has brought a wrong action. There is this advantage attending a nonsuit, that the plaintiff, though he pays costs, may afterwards bring another action for the same cause, which he cannot do after a verdict against him.

NORMAL, in geometry, signifies the same with a perpendicular, and is used for a line or plane that intersects another perpendicularly.

NOSE, the primary organ of smelling. See Anatomy.

NOSTOCK, the name of a vegetable substance which seems to differ from almost all others of the same kind. It is of a greenish colour, partly transparent, and of a very irregular figure. It trembles at the touch like jelly, but does not melt like that. It is found in all sorts of soils, but most frequently in sandy ones, sometimes on the gravel of garden walks, usually after rain in the summer months.

NOTARY, is a person duly appointed to attest deeds and writings; he also protests and notes foreign and inland bills of exchange, and promissory notes, translates languages, and attests the same, enters and extends ship's protests, &c.

NOTATION, in arithmetic and algebra, the method of expressing numbers or quantities by signs or characters, appropriated for that purpose.

Notation, in music, the manner of expressing, or representing by characters, all the different sounds used in music.

NOTE is a minute, or short writing, containing some article of business; in which sense we say, promissory note, note of hand, bank note. See Bills of Exchange.

NOTES, in music, characters which by their various forms and situations on the staves, indicate the duration as well as the gravity or acuteness of the several sounds of a composition.

NOTICE in law, is the making something known that a man was or might be ignorant of before, and it produces divers effects.

NOT GUILTY, is the general issue or plea of the defendant in any criminal action or prosecution; as also in an action of trespass, or upon the case for deceits and wrongs; but not on a promise or assumpsit.

NOUN, in grammar, a part of speech, which signifies things without any relation to time: as a man, a house, sweet, bitter, &c.

NUCLEUS, in general, denotes the kernel of a nut, or even any seed inclosed within a husk. The term nucleus is also used for the body of a comet, otherwise called its head.

NOVEL, in the civil law, a term used for the constitutions of several emperors, as of Justin, Tiberius, Leo, and more particularly for those of Justinian.

Novel *assignment*, or new assignment, a term in law pleadings which it is difficult to explain to those unacquainted with practical pleading. It occurs in actions of trespass, where the form of the declaration being very general, the defendant pleads in bar a common justification; to which the plaintiff replies by stating, that he brought his action as well for a certain other trespass which he states with more particularity, as for that which is justified. This is called a new assignment.

NOVEMBER, in chronology, the 11th month of the Julian year, consisting only of thirty days; it got the name of November, as being the ninth month of Romulus's year, which began with March.

NUDE *contract, nudum pactum*, a bare promise without any consideration, and not authenticated by deed, which is therefore void in law.

NUISANCE, signifies generally any thing that does hurt, inconvenience, or damage to the property or person of another. Nuisances are of two kinds, public and private, and either affect the public or the individual. The remedy for a private nuisance is by action on the case for damages, and for a public nuisance by indictment. Amongst the nuisances which most commonly occur are the erecting of

noxious manufactures in towns, and in the vicinity of ancient houses; such as the erecting a vitriol manufactory, to the annoyance of the neighbours in general. Disorderly houses, bawdy-houses, stage booths, lotteries, and common scolds, are also public nuisances. Where the injury is merely to an individual, and not to the public, the individual only has an action; but not in the case of a public nuisance, where the private injury is merged, or lost, in that of the public, but where an individual receives a particular injury by a public nuisance. And any one aggrieved may abate, that is, pull down and remove a nuisance, after which he can have no action: but this is a dangerous attempt to take the law into one's own hands. It must be done without riot, if at all. Every continuance of a nuisance is a fresh nuisance, and a fresh action will lie.

NUMBER, a collection of several units, or of several things of the same kind, as 2, 3, 4, &c. Number is unlimited in respect of increase; but in respect of decrease it is limited; unity being the first and least number.

NUMBERS, *kinds and distinctions of.* Mathematicians, considering number under a great many relations, have established the following distinctions. Broken numbers are the same with fractions. See ARITHMETIC. Cardinal numbers, are those which express the quantity of units, as 1, 2, 3, 4, &c. whereas ordinal numbers are those which express order, as 1st, 2d, 3d, &c. Compound number, one divisible by some other number besides unity; as 12, which is divisible by 2, 3, 4, and 6. Numbers, as 12 and 15, which have some common measure besides unity, are said to be compound numbers among themselves. Cubic number, is the product of a square number by its root: such is 27, as being the product of the square number 9, by its root 3.

Determinate number, is that referred to some given unit, as a ternary or three: whereas an indeterminate one, is that referred to unity in general, and is called quantity. Homogeneal numbers, are those referred to the same unit; as those referred to different units are termed heterogeneal. Whole numbers are otherwise called integers. Rational number, is one commensurable with unity; as a number, incommensurable with unity, is termed irrational or a surd. In the same manner a rational whole number is that whereof unity is an aliquot part; a rational broken number, that equal to some aliquot part of unity; and a rational mixed number, that consisting of a whole number and a broken one. Even number, that which may be divided into two equal parts without any fraction, as 6, 12, &c. An evenly even number, is that which may be measured, or divided, without any remainder, by another even number, as 4 by 2. An unevenly even number, when a number may be equally divided by an uneven number, as 20 by 5. Uneven number, that which exceeds an even number, at least by unity, or which cannot be divided into two equal parts, 3, 5, &c. Primitive, or prime numbers, are those only divisible by unity. Prime numbers among themselves, are those which have no common measure besides unity. Perfect number, that whose aliquot parts added together make the whole number. Imperfect numbers, those whose aliquot parts, added together, make either more or less than the whole. These are distinguished into abundant and defective; an instance in the former case, is 12, whose aliquot parts 6, 4, 3, 2, 1, make 16; and in the latter case 16, whose aliquot parts 8, 4, 2, and 1, make but 15. Plain number, that arising from the multiplication of two numbers, as 6, which is the product of 3 by 2; and these numbers are called the sides of the plane. Square number, is the product of any number multiplied by itself: thus 4, which is the factum of 2 by 2, is a square number Polygonal, or polygonous numbers, the sums of arithmetical progressions beginning with unity; these, where the common difference is, 1, are called triangular numbers; where 2, square numbers; where 3, pentagonal numbers; where 4, hexagonal numbers; where 5, heptagonal numbers, &c. Pyramidal numbers, the sums of polygonous numbers, collected after the same manner as the polygons themselves, and not gathered out of arithmetical progressions, are called first pyramidal numbers: the sums of the first pyramidals are called second pyramidals, &c. If they arise out of triangular numbers, they are called triangular pyramidal numbers; if out of pentagons, first pentagonal pyramidals. From the manner of summing up polygonal numbers, it is easy to conceive how the prime pyramidal numbers are found, viz.

$\frac{(a-2)n^3+3n^2-(a-5)n}{6}$ expresses all the prime pyramidals.

NUMBER, in grammar, a modification of nouns, verbs, &c. to accommodate them to the varieties in their objects, considered with regard to number.

NUMBERS, in poetry, oratory, music, &c. are certain measures, proportions, or cadences, which render a verse, period, or song, agree able to the ear.

NUMERAL *letters,* those letters of the alphabet which are generally used for figures, as I, V, X, L, C, D, M.

NUMERATION, or NOTATION, the art of expressing in characters any number proposed in words; or of expressing in words any number proposed in characters.

NUMERICAL, or NUMERAL, something belonging to numbers, as numerical algebra is that which makes use of numbers instead of letters of the alphabet.

NUMIDIA, the *Pintado,* or *guinea-hen,* in natural history, a genus of birds of the order gallinæ. Bill strong and short, with a carunculate cere at the base, in which the nostrils are lodged; head horned with a compressed coloured callus; wattels hanging from the cheeks; tail short, and pointing downwards; body speckled. There are four species. *N. meleagris,* is of the size of a very large fowl. Its native territory is Africa. It is gregarious, having been often seen in very numerous flocks. It is now extremely common in this country. The female lays many eggs, and secreting her nest, sometimes will suddenly appear with a family of twenty young ones. It is a bird of harsh sound, and almost perpetually uttering it. The flesh of the young birds is valued, and its eggs are thought preferable to those of the common hen.

NUNCIO or NUNTIO, an ambassador from

the pope to some catholic prince or state; or a person who attends on the pope's behalf at a congress, or an assembly of several ambassadors.

NUNCUPATIVE will, denotes a last will or testament, only made verbally, and not put in writing. See WILL and TESTAMENT.

NURSERY, is a piece of land set apart for raising and propagating trees and plants, to supply the garden and other plantations.

In a nursery for fruit trees, the following rules are to be observed, 1. That the soil should not be better than that in which the trees are to be planted out. 2. That it ought to be fresh. 3. It ought neither to be too wet, nor too dry, but rather of a middling nature, though of the two extremes, dry is to be preferred. 4. It must be inclosed in such a manner, that neither cattle nor vermin may come in; and so as particularly to exclude hares and rabbits. 5. The ground being inclosed, should be carefully trenched about two feet deep, in August. In trenching the ground, cleanse it from the roots of all noxious weeds. 6. The season being come for planting, level down the trenches about the beginning of October, and then lay out the ground into quarters, which may be laid out in beds for a seminary, in which you may sow the seeds or stones of fruit. 7. And having provided yourself with stocks, the next year proceed to transplant them: draw a line across the ground, and open a number of trenches exactly straight; then take the stocks out of the seed-beds; in doing which, you should raise the ground with a spade, in order to preserve the roots as entire as possible; prune off the very small fibres, and if there are any that have a tendency to root directly downwards, such roots should be shortened. Then plant them in the trenches, if they are designed for standards, in rows three feet and a half, or four feet, from each other, and a foot and a half distant in the rows; but if for dwarfs, three feet row from row, and one foot in the row, will be a sufficient distance. These plants should not be headed or pruned at top. If the winter should prove very cold, lay some muck on the surface of the ground near their roots, taking care not to let it lie too thick near the stems of the plants, and to remove it as soon as the frost is over. In the summer season destroy the weeds, and dig up the ground every spring between the rows. See GRAFTING.

As to timber trees, nurseries should be made upon the ground intended for planting, where a sufficient number of the trees may be left standing, after the others have been drawn out to plant in other places.

NUTATION, in astronomy, a kind of tremulous motion of the axis of the earth, whereby in each annual revolution it is twice inclined to the ecliptic, and as often returns to its former position.

NUT-GALLS are excrescences formed on leaves of the oak by the puncture of an insect which deposits an egg on them. The best are known by the name of Aleppo-galls, imported for the use of dyers, calico-printers, &c. See GALLIC ACID and TANNIN.

NUTMEG, the kernel of a large fruit, not unlike the peach, the produce of the MYRISTICA, which see.

The nutmeg is separated from its investient coat, the mace, before it is sent over to us. See MACE.

NUX *vomica*, a flat, compressed, round fruit, about the breadth of a shilling, brought from the East Indies. It is found to be a certain poison for dogs, cats, &c. For a more particular account of the nature of this poison, see the article STRYCHNIA.

NYMPH, among naturalists, that state of winged insects, between their living in the form of a worm, and their appearing in the winged or most perfect state. See ENTOMOLOGY.

NYMPHÆ, are two membranaceous parts, situated on each side the rima. They are of a red colour, and cavernous structure; they vary much in size in different persons; they are contiguous to the præputium of the clitoris, and joined to the interior side of the labia.

NYMPHÆA, the *water-lily*, a genus of the monogynia order, in the polyandria class of plants; and in the natural method ranking under the 54th order, miscellanea. The corolla is polypetalous; the calyx tetraphyllous or pentaphyllous: the berry multilocular and truncated. There are six species, of which the most remarkable are: 1 and 2. The *lutea* and *alba*, or yellow and white water lilies; both of which are natives of Britain, growing in lakes and ditches. Linnæus tells us, that swine are fond of the leaves and roots of the former; and that the smoke of it will drive away crickets and blattæ, or cock-roaches, out of houses. The root of the second has an astringent and bitter taste, like those of most aquatic plants that run deep into the mud. 3. The lotus, with heart-shaped toothed leaves, a plant thought to be peculiar to Egypt, is mentioned by Herodotus. M. Savary mentions it as growing in the rivulets and on the sides of the lakes; and that there are two sorts or varieties of the plant, the one with a white, the other with a blueish flower. The calyx blows like a large tulip, and diffuses a sweet smell, resembling that of the lily. The first species produces a round root like that of a potatoe; and the inhabitants of the banks of the lake Menzall feed upon it. The rivulets in the environs of Damietta are covered with this majestic flower, which rises upwards of two feet above the water. 4. In the East and West Indies grows a species of this plant, named nelumbo by the inhabitants of Ceylon. The flowers are large, flesh-coloured, and consist of numerous petals, disposed as in the other species of water-lily, in two or more rows. The seed vessel is shaped like a top, being broad and circular above, narrow and almost pointed below. It is divided into several distinct cells, which form so many large round holes upon the surface of the fruit, each containing a single seed. With the flower of this plant, which is sacred among the heathens, they adorn the altars of their temples. The stalks, which are used as a pot-herb, are of a wonderful length.

NYSSA, a genus of the order of diœcia, in the polygamia class of plants; and in the natural method ranking under the 12th order, holoraceæ. There are two species: 1. The integrifolia, entire-leaved; and, 2. The denticulata, or serrated-leaved tupelo.

O.

O, the fourteenth letter of our alphabet. As a numeral, it is sometimes used for eleven; and with a dash over it thus Ō for eleven thousand. In the notes of the ancients, O. CON. is read opus conductum; O. C. Q. opere consilioque; O. D. M. opera, donum, munus; and O. L. O. opus locatum.

In music, the O, or rather a circle, or double CO, is a note of time called by us a semi-breve; and by the Italians circolo. The O is also used as a mark of triple time, as being the most perfect of all figures.

OAK. See QUERCUS.

OAKAM, old ropes untwisted, and pulled out into loose hemp, in order to be used in caulking the seams, tree-nails, and bends of a ship, for stopping or preventing leaks.

OAR, in navigation, a long piece of wood, for moving a vessel by rowing. Oars for ships are generally cut out of fir timber, those for barges are made out of New England or Dantzic rafters, and those for boats, either out of English ash, or fir-rafters from Norway.

OAT. See AVENA.

OATH, an affirmation or denial of any thing before one or more persons, who have the authority to administer the same, for the discovery and advancement of truth and right. See AFFIDAVIT.

OBELISK, a truncated, quandrangular, and slender pyramid, raised as an ornament, and frequently charged either with inscriptions or hieroglyphics.

OBJECT, in philosophy, something apprehended, or presented to the mind, by sensation or by imagination.

OBJECT *glass of a telescope, or microscope*, the glass placed at the end of the tube which is next the object.

OBLATE, flatted, or shortened; as an oblate spheroid, having its axis shorter than its middle diameter, being formed by the rotation of an ellipse about the shorter axis.

OBLATENESS. See EARTH, *figure of*.

OBLIGATION, a bond containing a penalty, with a condition annexed, either for payment of money, performance of covenants, or the like. This security is called a specialty. Co. Lit. 172. See BOND, and DEED.

OBLIQUE, in geometry, something aslant, or that deviates from the perpendicular. Thus, an oblique angle, is either an acute or obtuse one; that is, any angle except a right one.

OBLIQUE PLANES. See DIALLING.

OBLONGATA MEDULLA. See ANATOMY.

OBOLUS, in antiquity, an ancient Athenian coin, worth a penny farthing. Among ancient physicians, obolus likewise denoted a weight, equal to ten grains.

OBOLARIA, a genus of the angiospermia order, in the didynamia class of plants; and in the natural method ranking under the 40th order, personatæ. The calyx is bifid; the corolla campanulated and quadrifid; the capsule unilocular, bivalved, and polyspermous; the stamina rising from the divisions of the corolla. There is one species, a herb of Virginia.

OBSERVATORY, a place destined for observing the heavenly bodies; being generally a building erected on some eminence, covered with a terrace for making astronomical observations.

The principal instruments for a fixed observatory are, a large fixed quadrant, or a circular divided instrument, chiefly for measuring vertical angles; a transit instrument; an equatorial instrument; a chronometer, or regulator; one or more powerful telescopes; a fixed zenith telescope, and a night telescope.

The quadrant, or quarter of a circle, divided into 90°, and each degree subdivided into minutes or smaller parts, has been made of various sizes; some of them having a radius even of eight or nine or more feet in length. When those quadrants do not exceed one or two, or at most three feet, in radius, they are generally fixed upon their particular stands, which are furnished with various mechanical contrivances, that are necessary to place the plane of the quadrant perpendicular to the horizon, and for all the other necessary adjustments. But large quadrants are fixed upon a strong wall.

The transit instrument consists of a telescope of any convenient length, fixed at right angles to a horizontal axis, which axis is supported at its two extremities; and the instrument is generally situated so that the line of collimation of the telescope may move in the plane of the meridian. The use of this instrument is to observe the precise time of the celestial bodies' passage across the meridian of the observatory.

To adjust the clock by the sun's transit over the meridian.—Note the times by the clock when the preceding and following edges of the sun's limb touch the cross wires. The difference between the middle time and 12 hours, shews how much the mean, or time by the clock, is faster or slower than the apparent, or solar time, for that day; to which the equation of time being applied, will show the time of mean noon for that day, by which the clock may be adjusted.

Astronomical or equatorial sector, an instrument for finding the difference in right ascension and declination between two objects, the distance of which is too great to be observed by the micrometer, was invented by Graham.

Equatorial or portable observatory: an instrument designed to answer a number of useful purposes in practical astronomy, independently of any particular observatory; it may be made use of in any steady room, and performs most of the useful problems in the science.

The principal uses of this equatorial are,

1. To find the meridian by one observation only: for this purpose elevate the equatorial circle to the co-latitude of the place, and set the declination-semicircle to the sun's declination for the day and hour of the day required; then move the azimuth and hour-circles both at the same time, either in the same or contrary directions, till you bring the centre of the cross hairs in the telescope exactly to

cover the centre of the sun; when that is done, the index of the hour-circle will give the apparent or solar time at the instant of observation; and thus the time is gained, though the sun is at a distance from the meridian; then turn the hour-circle till the index points precisely at 12 o'clock, and lower the telescope to the horizon, in order to observe some point there in the centre of your glass, and that point is your meridian mark found by one observation only: the best time for this operation is three hours before or three hours after 12 at noon.

2. To point the telescope on a star, though not on the meridian, in full day-light. Having elevated the equatorial circle to the co-latitude of the place, and set the declination-semicircle to the star's declination, move the index of the hour-circle till it shall point to the precise time at which the star is then distant from the meridian, found in tables of the right ascension of the stars, and the star will then appear in the glass. Besides these uses peculiar to this instrument, it is also applicable to all the purposes to which the principal astronomical instruments, viz. a transit, a quadrant, and an equal-altitude instrument, are applied.

Of all the different sorts of chronometers or timekeepers, a pendulum-clock, when properly constructed, is undoubtedly capable of the greatest accuracy, it being liable to fewer causes of obstruction or irregularity; therefore such machines are most recommendable for an observatory. The situation of this clock must be near the quadrant, and near the transit instrument; so that the observer, whilst looking through the telescope of any of those instruments, may hear the beats of the clock and count the seconds.

A pretty good telescope placed truly vertical in an observatory, is likewise a very useful instrument; as the aberration of the stars, latitude of the place, &c. may be observed and determined by the use of such an instrument, with great ease and accuracy.

The night telescope is a short telescope, which magnifies very little; but it collects a considerable quantity of light, and has a very great field of view; it therefore renders visible several dim objects, which cannot be discovered with telescopes of considerably greater magnifying powers, and hence it is very useful for finding out nebulæ, or small comets, or to see the arrangement of a great number of stars in one view.

The principal instruments that are at present used for marine astronomy, or for the purposes of navigation, are that incomparably useful instrument called Hadley's sextant, or quadrant, or octant; a portable chronometer; and a good telescope.

OBSIDIAN, in mineralogy, called also the Iceland agate, is found either in detached masses or forming a part of rocks. It has the appearance of black glass. It is usually invested with a grey or opaque crust. Its fracture is conchoidal. Specific gravity 2.35 nearly. Colour black, or greyish black; when in very thin pieces green. Very brittle. It melts into an opaque grey mass.

OCCULT, something secret, hidden, or invisible. The occult sciences are, magic, necromancy, cabbala, &c.

Occult, in geometry, is used for a line that is scarcely perceivable, drawn with the point of the compasses, or a leaden pencil. These lines are used in several operations, as the raising of plans, designs of building, pieces of perspective, &c. They are to be effaced when the work is finished.

OCCULTATION, in astronomy, the time a star or planet is hidden from our sight, by the interposition of the body of the moon, or of some other planet.

Occultation, *circle of perpetual*, is a parallel in an oblique sphere, as far distant from the depressed pole, as the elevated pole is from the horizon.

All the stars between this parallel and the depressed pole, never rise, but lie constantly hidden under the horizon of the place.

OCCUPANCY, in law, is a right which one acquires to a thing by being the first to gain possession of it. But this right is now chiefly done away by the English law.

OCEAN, in geography, that vast collection of salt and navigable waters, in which the two continents, the first including Europe, Asia, and Africa, and the last America, are inclosed like islands. The ocean is distinguished into three grand divisions. 1. The Atlantic Ocean, which divides Europe and Africa from America, which is generally about three thousand miles wide. 2. The Pacific Ocean, or South Sea, which divides America from Asia, and is generally about ten thousand miles over: and 3. The Indian Ocean, which separates the East Indies from Africa, which is three thousand miles over.

OCHRE, in natural history, a genus of earths, slightly coherent, and composed of fine, smooth, soft, argillaceous particles, rough to the touch, and readily diffusible in water. It is a combination of alumina and red oxide of iron.

OCTAGON, or **Octogon**, in geometry, is a figure of eight sides and angles; and this, when all the sides and angles are equal, is called a regular octagon, or one which may be inscribed in a circle.

Octagon, in fortification, denotes a place that has eight bastions.

OCTAHEDRON, or **Octaedron**, in geometry, one of the five regular bodies, consisting of eight equal and equilateral triangles. The octahedron is two pyramids put together at their bases; therefore its solidity may be found by multiplying the quadrangular base of either of them, by one third of the perpendicular height of one of them, and then doubling the product.

OCTANDRIA, the eighth class in Linnæus's sexual system; consisting of plants with hermaphrodite flowers, which are furnished with eight stamina, or male organs of generation.

OCTANT, or **Octile**, in astronomy, that aspect of two planets, wherein they are distant an eighth part of a circle, or 45°, from each other.

OCTAVE, in music, an interval containing seven degrees, or twelve semitones, and which is the first of the consonances in the order of generation.

OCTOBER, in chronology, the tenth month of the Julian year, consisting of thirty-one days: it obtained the name of October from its being the eighth month in the calendar

of Romulus. See the articles MONTH and YEAR.

ODE, in poetry, a song, or a composition proper to be sung. Among the ancients, odes signified no more than songs; but with us they are very different things. The ancient odes were generally composed in honour of their gods, as many of those of Pindar and Horace.

OESOPHAGUS, the gula, or gullet, is a membranaceous canal, reaching from the fauces to the stomach, and conveying into it the food taken in at the mouth. Its figure is somewhat like that of a funnel, and its upper part is called by anatomists the pharynx.

OESTRUS, a genus of insects of the order diptera: the generic character is, antennæ triarticulate, very short, sunk; face broad, depressed, vesicular; mouth, a simple orifice; feelers two, biarticulate, sunk; tail inflected. The genus *oestrus* or gad-fly is remarkable, like that of ichneumon, for the singular residence of its larvæ; viz. beneath the skin, or in different parts of the bodies of quadrupeds.

The principal European species is the oestrus bovis, or ox-gadfly. This is about the size of a common bee, and is of a pale yellowish-brown colour, with the thorax marked by four longitudinal dusky streaks, and the abdomen by a black bar across the middle, the tip being covered with tawny or orange-coloured hairs; the wings are pale brown, and unspotted.

The female of this species, when ready to deposit her eggs, fastens on the back of a heifer or cow, and piercing the skin with the tube situated at the tip of the abdomen, deposits an egg in the puncture; she then proceeds to another spot at some distance from the former, repeating the same operation at intervals on many parts of the animal's back. This operation is not performed without severe pain to the animal on which it is practised; and it is for this reason that cattle are observed to be seized with such violent horror when apprehensive of the approaches of the female oestrus: flying with uncontrolable rapidity, and endeavouring to escape their tormentor by taking refuge in the nearest pond; it being observed that this insect rarely attacks cattle when standing in water.

OFFENCE, is any act committed against any law. Offences are either capital or not capital. Capital offences are those for which an offender shall lose his life; not capital, where the offender may lose his lands and goods, be fined, or suffer corporal punishment, or both, but not loss of life.

OFFICE, is that function, by virtue whereof a person has some employment in the affairs of another. An office is a right to exercise any public or private employment, and to take the fees and emoluments thereunto belonging, whether public as those of magistrates, or private as of bailiffs, receivers, &c.

To offer money to any officer of state, to procure the reversion of an office in the gift of the crown, is a misdemeanor at common law, and punishable by information; and even the attempt to induce him, under the influence of a bribe, is criminal, though never carried into execution. An instance of which occurred under the administration of Mr. Addington, who prosecuted a tinman for offering a sum of money to him for a place in the customs.

Any contract to procure the nomination to an office, not within the statute 6, Edward VI, is defective on the ground of public policy; and the money agreed to be given is not recoverable.

OFFICER, a person possessed of a post or office. The great officers of the crown, or state, are the Lord High Steward, the Lord High Chancellor, the Lord High Treasurer, the Lord President of the Council, the Lord Privy Seal, the Lord Chamberlain, the Lord High Constable, the Earl Marshal.

OFFICERS, *field*, are such as command a whole regiment, as the colonel, lieutenant-colonel, and major.

OFFICERS, *general*, are those whose command is not limited to a single company, troop, or regiment; but extends to a body of forces, composed of several regiments: such are the general, lieutenant-general, major-generals, and brigadiers.

OFFICERS, *staff*, are such as, in the king's presence, bear a white staff, or wand; and at other times, on their going abroad, have it carried before them by a footman, bareheaded; such are the Lord Steward, Lord Chamberlain, Lord Treasurer, &c.

OFFICIAL, by the ancient law, signifies him who is the minister of, or attendant upon, a magistrate. In the canon law, it is especially taken for him to whom any bishop generally commits the charge of his spiritual jurisdiction; and in this sense there is one in every diocese called *officialis principialis*, whom the laws and statutes of this kingdom call chancellor. 32 Hen. VIII, 15.

OFFING, or **OFFIN**, that part of the sea a good distance from shore, where there is deep water, and no need of a pilot to conduct the ship.

OFF-SETS, are the young shoots that spring from the roots of plants; which being carefully separated, and planted in a proper soil, serve to propagate the species.

OFF-SETS, in surveying, are perpendiculars let fall, and measuring from the stationary lines to the hedge, fence, or extremity of an enclosure.

OGEE, or O. G. a moulding, consisting of two members, the one concave and the other convex; or, of a round and a hollow, like an S.

OIL. See CHEMISTRY.

OIL GAS. See GAS.

OLEA, the *olive-tree*, a genus of the monogynia order, in the diandria class of plants; and in the natural method ranking under the 44th order, sapieriæ. The corolla is quadrifid, with the segments nearly ovate. The fruit is a monospermous plum. There are seven species; the most remarkable are:

1\. The *Europea*, or common olive-tree, rises with upright solid stems, branching numerously on every side, 20 or 30 feet high; spear-shaped, stiff, opposite leaves, two or three inches long, and half an inch or more broad: and at the axillas small clusters of white flowers, succeeded by oval fruit. This species is the principal sort cultivated for its fruit; the varieties of which are numerous, varying in size, colour, and quality. It is a native of the southern parts of Europe, and is cultivated in great quantities in the south of France, Italy, and Portugal, for the fruit to make the olive-oil.

2\. The *Capensis*, or Cape box-leaved olive

3. *Olea odoratissima*, the flower of which is by some said to give the fine flavour to the green tea; but Thunberg attributes the flavour to the cemellie seserque.

Oil of olives is an ingredient in the composition of a great many balsams, ointments, plasters, mollifying and relaxing liniments. It is of an emollient and solvent nature; mitigates gripes of the colic, and the pains accompanying dysentery; and is supposed a good remedy when any person has chanced to swallow corrosive poisons.

OLEFIANT GAS. A compound of one prime of carbon and one of hydrogen, to which I have given, says Dr. Ure, the name of CARBURETTED HYDROGEN, to distinguish it from the gas resulting from one prime of carbon and two of hydrogen, which I have called sub-carburetted hydrogen.

OLEIC-ACID, so called by Chevreul, is an oily matter obtained from potass and hogs'-lard saponified. This substance, according to Mr. Brand, solidifies at about 40°, forming compounds called *oleates*.

OLIBANUM. A gum resin, the product of the Juniperus Lycia, *Linn.* brought from Turkey and the East Indies, usually in drops or tears. The best is of a yellowish-white colour, solid, hard, and brittle: when chewed for a little time, it renders the spittle white, and impresses an unpleasant bitterish taste; laid on burning coals, it yields an agreeable smell.

OLIGARCHY, a form of government wherein the administration of affairs is lodged in the hands of a few persons. See GOVERNMENT.

OLIVE. See OLEA.

OLYMPIC GAMES, were solemn games, famous among the ancient Greeks, so called from Olympian Jupiter, to whom they were dedicated.

OLIVINE. A sub-species of prismatic chrysolite. Its colour is olive-green. It occurs massive and in roundish pieces. Rarely crystallized in imbedded rectangular four-sided prisms. Lustre shining. Cleavage imperfect double. Fracture small grained uneven. Translucent. Less hard than chrysolite. Brittle. Sp. gr. 3.24. With borax it melts into a dark green bead.

OLLARIS LAPIS, or *potstone*, its constituents are, silica 39, magnesia 16, oxide of iron 10, carbonic acid 20, water 10. It occurs in thick beds in primitive slate. It is found abundantly on the shores of the lake Como in Lombardy. It is fashioned into culinary vessels in Greenland. It is a sub-species of the rhomboidal mica of Professor Jameson.

OMPHACITE, a mineral found in Carinthia; it is of a pale leek-green colour. It is found massive, disseminated, and in narrow radiated concretions. It is a variety of augite.

OMNIUM, a term in use among stockbrokers to express all the articles included in the contract between government and the original subscribers to a loan. Thus if the subscribers, according to their agreement with government are to have for every hundred pounds advanced a certain sum in 3 per cent. consols, a further sum in 4 per cents, and a proportion of the long annuities, the blank receipts which they receive for making the instalments on the several articles, are, when disposed of, independent of each other, as the 3 per cent. consols only, called scrip; but when the receipts are sold together as originally received, they are usually called omnium. As the omnium of every loan is the subject of extensive speculations, it generally is liable to considerable variations with respect to its current price, sometimes selling at a high premium, at other times at a discount, according to the circumstances which take place between the agreement for the loan and the day fixed for paying the last instalment.

ONION. See ALLIUM.

ONYX. See CHALCEDONY.

OPACITY, that property in bodies by which they are rendered impervious to the rays of light.

The cause of opacity in bodies does not consist, as was formerly supposed, in the want of rectilinear pores, pervious every way; but either in the unequal density of the parts, in the magnitude of the pores, or in their being filled with a matter, by means of which the rays of light in their passage are arrested by innumerable refractions and reflections, become extinct, and are absorbed.

OPAL, in mineralogy: this stone is found in many parts of Europe, especially in Hungary, in the Crapacks near the village of Czennizka. When first dug out of the earth it is soft, but it hardens and diminishes in bulk by exposure to the air. The substance in which it is found is a ferruginous sand stone.

According to Jameson there are seven kinds of opal, viz.—precious opal, common opal, fire opal, mother-of-pearl opal, semiopal, Jasper opal, and wood opal.

OPERA, a dramatic composition set to music, and sung on the stage, accompanied with musical instruments, and enriched with magnificent dresses, machines, and other decorations.

OPERA-*glass*, in optics, so called from its use in theatres, &c.; it is sometimes called a "diagonal perspective" from its construction. It consists of a tube about four inches long, in each side of which there is a hole exactly against the middle of a plane mirror, which reflects the rays falling upon it, to the convex glass, through which they are re-refracted to the concave eye-glass, whence they emerge parallel to the eye at the hole in the tube. This instrument is not intended to magnify objects more than about two or three times. The peculiar artifice is to view a person at a small distance, so that no one shall know who is observed: for the instrument points to a different object from that which is viewed; and as there is a hole on each side, it is impossible, to know on which hand the object is situated, which you are looking at.

OPHIDIUM, in natural history, a genus of fishes of the order Apodes. Generic character: the head rather naked; teeth in the jaws, palate, and throat; gill membrane seven-rayed; body in the form of a sword. There are four species. We shall notice only O. *barbatum*, or the bearded ophidium: this is generally about eight inches long, and is a native of the Adriatic and Mediterranean Seas.

OPHTHALMIA, in medicine, an inflammation of the membranes which invest the eye.

OPIUM, in chemistry and medicine, an inspissated gummy juice, which is obtained from the head of the "papaver somniferum." It is imported from Persia, Arabia, and other warm parts of Asia, in flat cakes covered with leaves to prevent their sticking together. It has a reddish brown colour, and strong peculiar smell; its taste at first is nauseous and bitter; but this soon becomes acrid, and produces a slight warmth in the mouth. A peculiar substance has been detected in opium, to which it is supposed the properties it possesses of producing sleep are owing. On account of this property, this substance has received the name of narcotic matter. It is obtained from the milky juices of some plants, as those of the poppy, lettuce, and some others.

OPOBALSAMUM, or *balm of Gilead*, a resin obtained from the amyris Gileadensis, a tree which grows in Arabia, especially near Mecca. It is so much valued by the Turks, that it is rarely imported into Europe.

The true balsam is of a pale yellowish colour, clear and transparent, about the consistence of Venice turpentine, of a strong, penetrating, agreeable, aromatic smell, and a slightly bitterish purgent taste. By age it becomes yellower, browner, and thicker, losing by degrees, like volatile oils, some of its finer and more subtile parts.

OPODELDOC. A solution of soap in alcohol, with the addition of camphor and volatile oils. It is used externally against rhumatic pains, sprains, bruises, and other like complaints.

OPOPANAX. A concrete gummy resinous juice, obtained from the roots of an umbelliferous plant, the pastinaca opopanax, *Linn.* which grows spontaneously in the warmer countries, and bears the cold of this.

OPTICS. This word is derived from the Greek term *οπτομαι*, *I see*, and is used to denote that branch of natural philosophy which treats of the nature and properties of light, and of the changes which it undergoes either in its direction when transmitted through bodies, either natural or artificial,—when reflected from their surfaces, or when passing by them at a small distance.

Definitions.

1. Light is a substance, the particles of which are extremely small, and these by striking on our visual organs, give us the sensation of seeing.

2. The particles of light are emitted from what are called luminous bodies, such as the sun, a fire, a torch, or candle, &c. &c. It is reflected or sent back by what are termed opaque bodies, or those which have no power of affording light in themselves.

3. Light, whether emitted or reflected, always moves in straight or direct lines, as may easily be proved by looking into a bent tube, which evidently obstructs the progress of the light in direct lines.

4. By a ray of light, is usually meant the least particle of light that can be either intercepted or separated from the rest. A beam of light is generally used to express something of an aggregate or mass of light greater than a single ray.

5. Parallel rays are such as proceed equally distant from each other through their whole course. The distance of the sun from the earth is so immense, that rays proceeding from the body of that luminary are generally regarded as parallel.

6. Converging rays are such as, proceeding from any body, approach nearer and nearer to each other, and tend to unite in a point. The form of rays thus tending to an union in a single point has been compared to that of a candle-extinguisher; it is in fact a perfect cone.

7. Diverging rays are those which, proceeding from a point continue to recede from each other, and exhibit the form of an inverted cone.

8. A small object, or a small single point of an object, from which rays of light diverge, or indeed proceed in any direction, is sometimes called the radiant, or radiant point.

9. Any parcel of rays, diverging from a point, considered as separate from the rest, is called a pencil of rays.

10. The focus of rays is that point to which converging rays tend, and in which they unite and intersect, or cross each other. It may be considered as the apex or point of the cone; and it is called the focus (or fire-place), because it is the point at which burning-glasses burn most intensely.

11. The virtual or imaginary focus is that supposed point behind a mirror or looking glass, where the rays would have naturally united, had they not been intercepted by the mirror.

12. Plane mirrors or speculums are those reflecting bodies, the surfaces of which are perfectly plain or even, such as our common looking-glasses. Convex and concave mirrors are those the surfaces of which are curved.

13. An incident ray is that which comes from any body to the reflecting surface; the reflecting ray is that which is sent back or reflected.

14. The angle of incidence is the angle which is formed by the line which the incident ray describes in its progress, and a line drawn perpendicularly to the reflecting surface: and the angle of reflection is the angle formed by the same perpendicular and reflected ray. The angle comprehended between the incident ray and the perpendicular, is the angle of incidence; and that between the refracted ray and the perpendicular, is the angle of refraction.

15. By a medium opticians mean any thing which is transparent, such as void space, air, water, or glass, through which consequently the rays of light can pass in straight lines.

16. The refraction of the rays of light is their being bent, or attracted out of their course, in passing obliquely from one medium to another of a different density, and which causes objects to appear broken or distorted, when part of them is seen in a different medium.

17. A lens, is glass ground into such a form as to collect or disperse the rays of light which pass through it. These are of different shapes, and from thence receive different names. A plano convex has one side flat, and the other convex, as A (plate XXXVIII, fig. 1.) A plano-concave is flat on one side, and concave on the other, as B. A double convex, is convex on both sides as C. A double concave, is concave on both sides, as D,

A meniscus, is convex on one side and concave on the other, as E. A line passing through the centre of a lens, as FG, is called its axis.

18. Vision is performed by a contrivance of this kind. The crystalline humour, which is seated in the fore-part of the human eye, immediately behind the pupil, is a perfect convex lens.

19. The magnitude of the image painted on the retina will also depend on the greatness or obtuseness of the angle under which the pencil of rays proceeding from the extreme points of the object enters the eye.

20. The prism used by opticians is a triangular piece of fine glass, which has the power of separating the rays of light.

Of Refraction.

If the rays of light, after passing through a medium, enter another of a different density perpendicular to its surface, they proceed through this medium in the same direction as before. Thus the ray O P, fig. 2, proceeds to K, in the same direction. But if they enter obliquely to the surface of a medium, either denser or rarer than what they moved in before, they are made to change their direction in passing through that medium. If the medium which they enter be denser, they move through it in a direction nearer to the perpendicular drawn to its surface. Thus A C, upon entering the denser medium H G K instead of proceeding in the same direction A L is bent into the direction C F, which makes a less angle with the perpendicular O P. On the contrary, when light passes out of a denser into a rarer medium, it moves in a direction farther from the perpendicular. Thus, if S C were a ray of light which had passed through the dense medium H G K, on arriving at the rarer medium it would move in the direction C A, which makes a greater angle with the perpendicular. This refraction is greater or less, that is, the rays are more or less bent or turned aside from their course, as the second medium through which they pass is more or less dense than the first.

Upon a smooth board, about the centre C, describe a circle H O K P; draw two diameters of the circle, O P, H K, perpendicular to each other; draw A D M perpendicular to O P; cut off D T and C I equal to three-fourths D A; through T I, draw T I S, cutting the circumference in S; N S drawn from S perpendicularly upon O P, will be equal to D T, or three-fourths of D A. Then if pins be stuck perpendicularly at A, C, and S, and the board be dipped in the water as far as the line H K, the pin at S will appear in the same line with the pins at A and C. This shews, that the ray which comes from the pin S is so refracted at C, as to come to the eye along the line C A; whence the sine of incidence A D is to the sine of refraction N S, as 4 to 3. If other pins were fixed along C S, they would all appear in A C produced; which shows that the rays are bent at the surface only. The same may be shewn, at different inclinations of the incident ray, by means of a moveable rod turning upon the centre C, which always keep the ratio of the sines A D, N S, as 4 to 3. Also the sun's shadow, coinciding with A C, may be shown to be refracted in the same manner The image L, of a small object S, placed under water is one-fourth nearer the surface than the object. And hence the bottom of a pond, river, &c. is one-third deeper than it appears to a spectator.

To prove the refraction of light in a different way, take an upright empty vessel into a dark room; make a small hole in the window-shutter, so that a beam of light may fall upon the bottom at *a*, fig. 3, where you may make a mark. Then fill the bason with water, without moving it out of its place, and you will see that the ray, instead of falling upon *a*, will fall at *b*. If a piece of looking-glass be laid in the bottom of the vessel, the light will be reflected from it, and will be observed to suffer the same refraction as in coming in; only in a contrary direction. If the water be made a little muddy, by putting into it a few drops of milk, and if the room be filled with dust, the rays will be rendered much more visible.

On the subject of *double refraction*, some remarks will be found under the article *Polarization of Light*, to which the reader is referred.

On Reflexion.

When a ray of light falls upon any body, it is reflected, so that the angle of incidence is equal to the angle of reflection; and this is the fundamental fact upon which all the properties of mirrors depend. Let a ray of light, passing through a small hole into a dark room, be reflected from a plane mirror, at equal distances from the point of reflection, the incident, and the reflected ray, will be at the same height from the surface.

Again, if from a centre, C, with the radius, CA, the circle, A M P, be described, the arc, AO, will be found equal to the arc, O M, therefore the angle of incidence is equal to the angle of reflection. The same is found to hold in all cases when the rays are reflected at a curved surface, whether it be convex or concave. The rays which proceed from any remote terrestrial object, are nearly parallel at the mirror; not strictly so, but come diverging to it in separate pencils, or, as it were, bundles of rays, from each point of the side of the object next the mirror; therefore they will not be converged to a point at the distance of half the radius of the mirror's concavity from its reflecting surface, but in separate points at a little greater distance from the mirror. And the nearer the object is to the mirror, the further these points will be from it; and an inverted image of the object will be formed in them, which will seem to hang pendent in the air; and will be seen by an eye placed beyond it (with regard to the mirror,) in all respects like the object, and as distinct as the object itself.

If a man place himself directly before a large concave mirror, but further from it than its centre of concavity, he will see an inverted image of himself in the air, between him and the mirror, of a less size than himself. And if he hold out his hand towards the mirror, the hand of the image will come out towards his hand, and coincide with it, of an equal bulk, when his hand is in the centre of concavity; and he will imagine he may shake hands with his image. If he reach his hand further, the hand of the image will pass by his hand, and

come between it and his body; and if he move his hand towards either side, the hand of the image will move towards the other; so that whatever way the object moves, the image will move the contrary way. A by-stander will see nothing of the image, because none of the reflected rays that form it enter his eyes.

The images formed by convex specula are in positions similar to those of their objects; and those also formed by concave specula, when the object is between the surface and the principal focus: in these cases the image is only imaginary, as the reflected rays never come to the foci from whence they seem to diverge. In all other cases of reflexion from concave specula, the images are in positions contrary to those of their objects, and these images are real, for the rays after reflexion do come to their respective foci.

Of Colours.

The origin of colours is owing to the composition which takes place in the rays of light, each heterogeneous ray consisting of innumerable rays of different colours; this is evident from the separation that ensues in the well-known experiment of the prism. A ray being let into a darkened room, fig. 4, through a small round aperture *z*, and falling on a triangular glass prism, *x*, is by the refraction of the prism considerably dilated, and will exhibit on the opposite wall an oblong image, *a b*, called a spectrum, variously coloured, the extremities of which are bounded by semicircles, and the sides are rectilinear. The colours are commonly divided into seven, which, however, have various shades, gradually intermixing at their juncture. Their order, beginning from the side of the refracting angle of the prism, is red, orange, yellow, green, blue, purple, violet.

The obvious conclusion from this experiment is, that the several component parts of solar light have different degrees of refrangibility, and that each subsequent ray in the order above mentioned is more refrangible than the preceding.

As a circular image would be depicted by the solar ray unrefracted by the prism, so each ray that suffers no dilatation by the prism, would mark out a circular image. Hence, it appears, that the spectrum is composed of innumerable circles of different colours. The mixture, therefore, is proportionable to the number of circles mixed together; but all such circles are mixed together, whose centres lie between those of two contingent circles, consequently the mixture is proportionable to the interval of those centres, *i. e.* to the breadth of the spectrum. If, therefore, the breadth can be diminished, retaining the length of the rectilinear sides, the mixture will be lessened proportionably, and this is done by the following process.

At a considerable distance from the hole *z*, place a double convex lens, fig. 5, whose focal length is equal to half that distance, and place the prism *x* behind the lens; at a distance behind the lens, equal to the distance of the lens from the hole, will be formed a spectrum, the length of whose rectilinear sides is the same as before, but its breadth much less; for the undiminished breadth was equal to a line subtending, at the distance of the spectrum from the hole, an angle equal to the apparent diameter of the sun, together with a line equal to the diameter of the hole; but the reduced breadth is equal to the diameter of the hole only. The image of the hole formed by the lens, at the distance of double its focal length, is equal to the hole; therefore, its several images in the different kinds of rays are equal to the same, *i. e.* the breadth of the reduced spectrum is equal to the diameter of the hole

A prism placed in an horizontal position would project the ray into an oblong form apply another horizontal prism, similar to the former, to receive the refracted light emerging from the first; and having its refracted angle turned the contrary way from that of the former, the light, after passing through both prisms, will assume a circular form, as if it had not been at all refracted.

If the light emerging from the first prism be received by a second, whose axis is perpendicular to that of the former, it will be refracted by this transverse prism into a position inclined to the former, the red extremity being least, and the violet most removed from its former position; but it will not be at all altered in breadth.

Close to the prism A, fig. 6, place a perforated board *a b*, and let the refracted light, having passed through the small hole, be received on a second board *c d*, parallel to the first, and perforated in like manner: behind that hole in the second board, place a prism, with its refracting angle downward; turn the first prism slowly about its axis, and the light will move up and down the second board let the colours be transmitted successively, and mark the places of the different coloured rays on the wall after their refraction by the second prism, the red will appear lowest, the violet highest, the rest in the intermediate places in order. Here, then, the light being very much simplified, and the incidences of all the rays on the second prism exactly the same; the red was least refracted, the violet most, &c.

The permanency of these original colours appears from hence, that they suffer no manner of change by any number of refractions, as is evident from the last mentioned experiment; nor yet by reflexion; for if any coloured body be placed in simplified homogeneous light, it will always appear of the same colour of the light in which it is placed, whether that differ from the colour of the body or not; *e. g.* if ultramarine and vermilion be placed in red light, both will appear red; in a green light, green; in a blue light, blue, &c. It is, however, to be allowed, that a body appears brighter when in a light of its own colour than in another; and from this we see that the colours of natural bodies arise from an aptitude in them to reflect some rays more copiously and strongly than others; but lest this phenomenon should produce a doubt of the constancy of the primary colours, it is proper to assign the reason of it, which is this: that when placed in its own coloured light, the body reflects the rays of the predominant colour more strongly than any of those intermixed with it; therefore the proportion of the rays of the predominant colour to those of the others, in the reflected light, will be greater than in the incident light; but when the body is placed in a light of a different colour from its own, for a similar reason the contrary effect

will follow; *i. e.* the proportion of the predominant colour to the others will be less in the reflected than in the incident light, and therefore as its splendor would be greater in the former case, and would be less in the latter than if all the rays were equally reflected, the splendour of the predominant colour will be much greater in the former case than in the latter.

White is compounded of all the primary colours mixed in their due proportions; for if a solar ray be separated by the prism into its component parts, and at a proper distance a lens be so placed as to collect the diverging coloured rays again into a focus, a paper placed perpendicularly to the rays in this point will exhibit whiteness.

The following is a very pleasing and satisfactory method of illustrating this fact.

Draw two concentric circles, fig. 7, on a piece of stiff card-paper; from the centre draw the lines A B C D E F G, to the circumference of the outer circle, making them at the distance from each other in degrees as expressed in the figure. Then between the two circles paint the space A G red, inclining to orange near G; G F orange, inclining to yellow near F; F E yellow, inclining to green near E; E D green, inclining to blue near D; D C blue, inclining to indigo near C; C B indigo, inclining to violet near B; and B A violet, inclining to a soft red near A.

Let all that part of the card within the inner circle be painted black. If now an axis be passed through the centre of the card, and the card made to revolve very rapidly upon it, the whole of the colours will appear so blended together as to present the appearance of a white ring, inclining a little to grey. Any of these colours may be made by mixing together the two contiguous prismatic colours.

Though seven different colours are distinguishable in the prismatic spectrum, yet, upon examining the matter with more accuracy, we shall see that there are, in fact, only three original colours, red, blue, and yellow; for the orange being situated between the red and yellow, is only the mixture of these two: the green, in like manner, arises from the blue and yellow; and the violet from the blue and red.

As the colour of a body, therefore, proceeds from a certain combination of the primary rays which it reflects, the combination of rays flowing from any point of an object will, when collected by a glass, exhibit the same compound colour in the corresponding point of the image. Hence appears the reason why the images formed by glasses have the colours of the object which they represent.

Of Vision.

The eye is nearly of a spherical shape, and is composed of three different substances, called, 1. The aqueous, P, fig. 8. 2. The crystalline, R; and 3, the vitreous humours, V, enclosed by three principal coats, which are formed by the expansion of the different component parts of the optic nerve, *viz.* the sclerotica, S S. 2. The choroides, D D; and 3. The retina, T T. The sclerotica is outermost; it is very strong, and the fore part, which is transparent, and somewhat prominent, is called the cornea, C. The choroides is next in order, and has a circular perforation, P, called the pupil, immediately behind the middle of the cornea: the part H of the choroides, visible behind the cornea, is flat; it is called the iris, or uvea, and is differently coloured in different persons. The retina is the inmost coat; it extends round the eye till it meets the ciliary ligaments, Q Q, membranes proceeding from the choroides and attached to the capsula or filament, which incloses the crystalline humour, R. The crystalline is the most dense of the three humours, and is in the shape of a double convex lens, whose fore part has the less curvature; the cavity between the cornea and the crystalline is occupied by the aqueous humour, which has rather the least density of the three, and the space between the bottom of the eye and the crystalline is filled by the vitreous humour V.

Objects presented to the eye have their images painted on the back part of the retina, the rays of the incident pencils converging to their proper foci there by the refraction of the different humours; and for this office they are admirably adapted; for as the distance between the back and front of the eye is very small, and the rays of each of the pencils that form the image fall parallel, or else diverging on the eye, a strong refractive power is necessary for bringing them to their foci at the retina; but each of the humours, by its peculiar form and density, contributes to cause a convergence of the rays: the aqueous from its convex form; the crystalline by its double convexity and greater density than the aqueous; and the vitreous by a less density than the crystalline joined to its concave form.

The structure of the eye is in general adapted to the reception of parallel rays, but as the distances of visible objects are various, so the eye has powers of accommodating itself to rays proceeding from different distances by altering the distances of the crystalline from the retina, which is done by the action of the ciliary ligaments.

Defective sight arises from an incapacity of altering the position of the crystalline within the usual limits. 1. When it cannot be brought close enough to the cornea, near objects appear indistinct; to this defect people in years are generally subject. 2. Where the crystalline cannot be drawn sufficiently near to the retina, remote objects appear indistinct; this is the defect under which short-sighted people labour. In each of these cases the images of the different points in the object would be diffused over small circles on the retina; and so being intermixed and confounded with each other, would there form a very confused picture of the object; for in the former case, fig. 5, the image of any point would be formed behind the retina, as the refraction of the eye is not sufficiently strong to bring the rays (diverging so much as they do in proceeding from a near point) to a focus at the retina. This defect will therefore be remedied by a convex glass *ab*, which makes the point whence the rays now proceed more distant than the object: therefore the rays falling on the eye will now diverge less than before, or else be parallel, and will of course be brought to a nearer focus, viz. at the retina.

In the latter case, the image is formed before the retina, fig. 6, because the refractive power of the eye is too great to permit rays so little diverging (as they do in proceeding

from a distant point) to reach the retina before they are collected into a focus; in this case the defect is supplied by a concave glass, which makes the point whence the rays diverge, nearer than the object: consequently, the rays falling on the eye will now diverge more than before, so as when refracted through the humours not to come to their focus before they reach the retina. Therefore spectacles are constructed concave for short-sighted, and convex for long-sighted people.

Of Optical Instruments.

From what has been stated concerning vision, the principle of the single microscope will be easily understood. Since the eye cannot have a distinct preception of any object at a nearer distance than six or eight inches, and since there are many objects which at that distance must be wholly imperceptible, or at best appear as points, an instrument which can render them visible, is a very desirable attainment.

The most powerful single microscopes are very small globules of glass, which any curious person may make for himself by melting the ends of fine threads of glass in the flame of a candle; or by taking a little fine powdered glass on the point of a very small needle, and melting it into a globule in that way. It was with such microscopes as these that Lewenhoeck made all his wonderful discoveries, most of which are deposited in the British Museum.

The double or compound microscope differs from the preceding in this respect, that it consists of at least two lenses, by one of which an image is formed within the tube of the microscope; and this image is viewed through the eye-glass, instead of the object itself as in the single microscope. In this respect the principle is analogous to that of the telescope, only that, as the latter is intended to view distant objects, the object-lens, is of a long focus, and consequently of a moderate magnifying power, and the eye-glass of a short focus, which magnifies considerably the image made by the object-lens. Whereas the microscope being intended only for minute objects, the object-lens is consequently of a short focus, and the eye-glass in this case is not of so high a magnifying power.

A single figure will serve to explain the principles on which all these instruments are constructed. Suppose therefore L N, fig. 9, to be the object-lens, and F G to be the eye-glass. The object O B is placed a little beyond the principal focus of L N. The cones or pencils of rays then proceeding from the different points of the object, are by the lens made to converge to their respective foci, and form an inverted image of the object at P Q. This image is seen through the eye-glass F G, and the rays of each pencil will proceed in a parallel direction to the pupil of the eye.

The solar microscope is a kind of camera obscura, which, in a darkened chamber, throws the image on a wall or screen. It consists of two lenses fixed opposite a hole in a board or window-shutter; one, which condenses the light of the sun upon the object (which is placed between them), and the other which forms the image. There is also a plain reflector placed without, moved by a wheel and pinion, which may be so regulated as to throw the suns's rays upon the outer lens. Mr. Adam's most ingenious invention, the lucernal microscope, is also to be considered as a kind of camera obscura; only the light in this latter case proceeds from a lamp, instead of from the sun, which renders it convenient to be used in all times. But for a description of this elegant and most amusing instrument, we must refer to his Microscopical Essays.

From what has been said on the nature of the compound microscope, the principle of the telescope may be easily understood. Telescopes are, however, of two kinds: the one depending on the principle of refraction, and called the dioptric-telescope; the other on the principle of reflexion, and therefore termed the reflecting telescope.

The parts essential to a dioptric-telescope are, the two lenses A D and E Y, fig. 10. As in the compound microscope, A D is the object-glass, and E Y is the eye-glass; and these glasses are so combined in the tube, that the focus F of the one is exactly coincident with the focus of the other.

Let O B then represent a very distant object, from every point of which pencils of rays will proceed so little diverging to the object-lens A D, that they may be considered as nearly parallel; I M will then be the image which would be formed on a screen by the action of the lens A D. For supposing O A and B D two pencils of rays proceeding from the extreme points of the object, they will unite in the focal point F, and intersect each other. But the point F is also the focus of the eye-glass E Y; and therefore the pencil of rays, instead of going on to diverge, will pass through it in nearly a parallel direction, so as to cause distinct vision. It is then plain that, as in the compound microscope, it is the image which is here contemplated; and this will account for the common sensation when people say the object is brought nearer by a telescope. For the rays, which after crossing proceed in a divergent state, fall upon the lens E Y, as if they proceeded from a real object situated at F. All that is effected by a telescope then is, to form such an image of a distant object, by means of the object-lens, and then to give the eye such assistance as is necessary for viewing that image as near as possible; so that the angle it shall subtend at the eye shall be very large compared with the angle which the object itself would subtend in the same situation. This is effected by means of the eye-glass which refracts the pencils of rays, so that they may be brought to their several foci by the humours of the eye, as has been described. To explain clearly, however, the reason why it appears magnified, we must again have recourse to the figure. O B being at a great distance, the length of the telescope is inconsiderable with respect to it. Supposing, therefore, the eye viewed it from the centre of the object-glass C, it would see it under the angle O C B: let O C and B C then be produced to the focus of the glass, they will then limit the image I M formed in the focus If these two parallel rays are supposed to proceed to the eye-glass E Y, they will be converged to its focus H, and the eye will see the image under the angle E H Y. The ap-

parent magnitude of the object seen by the naked eye is, therefore, to that of the image which is seen through the telescope, as the magnitude of the angle O C B, or I C M, to that of E H Y, or I G M. Now the angle I G M is *to* I C M as C F to F G; *that is*, as the focal length of the object-glass *to that of* the eye-glass.

The magnifying power of these glasses may be augmented to a considerable degree, because the focal length of the object-glass, with respect to that of the eye-glass, may be greatly increased. This, however, would require a tube of immense length; because an eye-glass of a very short focus would cause such a dispersion of the rays of light, particularly towards the edges of the glass, that the view would be intercepted by the prismatic colours.

Another manifest defect in these telescopes is, that the image appears inverted; this, however, is of no consequence with respect to the heavenly bodies; and on this account it is still used as an astronomical telescope. One of almost a similar construction is also used on board of ships as a night-glass, to discover rocks in the ocean, or an enemy's fleet. Notwithstanding the inconvenience of exhibiting the objects inverted, more glasses than two cannot be employed from the paucity of light; and habit soon enables the persons who use them to discern objects with tolerable distinctness.

The brightness of the appearance through any of these telescopes or microscopes, depends chiefly on the aperture of the object-glass. For if the whole of that glass was covered except a small aperture in the middle, the magnitude of the image would not be altered; but fewer rays of every pencil being admitted, the object would appear obscure. In few words, the apparent distinctness or confusion of any object, viewed through glasses, depends on the mutual inclinations of the rays in any one pencil to each other, when they fall on the eye; the apparent magnitude depends upon the inclination of the rays of different pencils to each other; the apparent situation depends upon the real situation of the extreme pencils; and the apparent brightness or obscurity depends on the quantity of rays in each pencil. The well-known property in concave speculums, of causing the pencils of rays to converge to their foci, and there forming an image of an object that may be opposed to them, gave rise to the reflecting telescope. In this the effect is precisely the same as that produced by the dioptric telescope; only that in the one case it is produced by reflected, and in the other by refracted, light. Reflecting telescopes are made in various forms; and those principally in use in this country are distinguished by the names of their respective inventors, and are called the Newtonian, Gregorian, and Herschelian telescopes. The reflecting telescope on the Gregorian principle, which is the most common, as it is found to be the most convenient, is constructed in the following manner:—At the bottom of the great tube, plate XXXIX, fig. 1, T T T T, is placed a large concave mirror D U V F, whose principal focus is at *m*; and in the middle of this mirror is a round hole P, opposite to which is placed the small mirror L, concave toward the great one; and so fixed to a strong wire M that it may be removed further from the great mirror, or nearer to it by means of a long screw on the inside of the tube, keeping its axis still in the same line P *m n* with that of the great one. Now, since in viewing a very remote object, we can scarcely see a point of it but what is, at least, as broad as the great mirror, we may consider the rays of each pencil, which flow from every point of the object, to be parallel to each other, and to cover the whole reflecting surface D U V F. But to avoid confusion in the figure, we shall only draw two rays of a pencil flowing from each extremity of the object into the great tube; and trace their progress through all their reflections and refractions to the eye *f* at the end of the small tube *t t*, which is joined to the great one.

Let us then suppose the object AB to be at such a distance, that the rays C may flow from its upper extremity A, and the rays E from its lower extremity B; then the rays C falling parallel upon the great mirror at D, will be thence reflected converging in the direction D G: and by crossing at I in the principal focus in the mirror, they will form the lower extremity of the inverted image I K, similar to the upper extremity A of the object A B; and passing on to the concave mirror L (whose focus is at *n*), they will fall upon it at *g*, and be thence reflected, converging in the direction *g* N, because *g m* is longer than *g n*: and passing through the hole P in the large mirror, they would meet somewhere about *r*, and form the upper extremity *a* of the erect image *ab*, similar to the upper extremity A of the object AB.

But by passing through the plano convex-glass R in their way, they form that extremity of the image at *a*. In the same manner the rays E, which come from the bottom of the object AB, and fall parallel upon the great mirror at F, are thence reflected, converging to its focus; where they form the upper extremity I of the inverted image I K, similar to the lower extremity B of the object A B: and thence passing on to the small mirror L, and falling upon it at *h*, they are thence reflected in the converging state *h* O; and going on through the hole P of the great mirror, they would meet somewhere about *q*, and form there the lower extremity *b* of the erect image *a b*, similar to the lower extremity B of the object A B; but by passing through the convex glass R in their way, they meet and cross sooner, as at *b*, where that point of the erect image is formed. The like being understood of all those rays which flow from the intermediate points of the object between A and B, and enter the tube T T, all the intermediate points of the image between *a* and *b* will be formed; and the rays passing on from the image through the eye-glass S, and through a small hole *e* in the end of the lesser tube *t t*, they enter the eye *f*, which sees the image *a b* (by means of the eye-glass) under the large angle *c e d*, and magnified in length under that angle from *c* to *d*.

In the best reflecting telescopes, the focus of the small mirror is never coincident with the focus *m* of the great one, where the first image I K is formed, but a little beyond it (with respect to the eye) as at *n*; the consequence of which is, that the rays of the pen-

cils will not be parallel after reflection from the small mirror, but converge so as to meet in points about *q, e, r:* where they would form a larger upright image than *ab*, if the glass R was not in their way, and this image might be viewed by means of a single eye-glass properly placed between the image and the eye; but then the field of view would be less, and consequently not so pleasant; for that reason the glass R is still retained, to enlarge the scope or area of the field.

To find the magnifying power of this telescope, multiply the focal distance of the great mirror by the distance of the small mirror from the image next the eye, and multiply the focal distance of the small mirror by the focal distance of the eye-glass; then divide the product of the former multiplication by that of the latter, and the quotient will express the magnifying power. The difference between the Newtonian and Gregorian telescope is, that in the former the spectator looks in at the side through an aperture upon a plane mirror, by which the rays reflected from the concave mirror are reflected to the eye-glass; whereas in the latter the reader will see that he looks through the common eye-glass, which is in general more convenient.

The immensely powerful telescopes of Dr. Herschel are of a still different construction. This assiduous astronomer has made several specula, which are so perfect as to bear a magnifying power of more than six thousand times in diameter on a distant object. The object is reflected by a mirror as in the Gregorian telescope, and the rays are intercepted by a lens at a proper distance, so that the observer has his back to the object, and looks through the lens at the mirror. The magnifying power will in this case be the same as in the Newtonian telescope; but there not being a second reflector, the brightness of the object viewed in the Herschelian is greater than that in the Newtonian or Gregorian telescope. In conclusion, Sir Isaac Newton's excellent maxim must not be omitted: "The art," says he, "of constructing good microscopes and telescopes may be said to depend on the circumstance of making the last image as large and distinct and luminous as possible.

The camera obscura is an instrument used to facilitate the delineation of prospects. It is constructed in the following manner: A C, fig. 2. represents a box of about a foot and a half square, shut on every side, except D C; O P is a smaller box placed on the top of the greater; N N is a double convex lens, whose axis makes an angle of 45° with B L, a plane mirror fixed in the box O P; the focal length of the lens is nearly equal to C S + S T, *i. e.* to the sum of the distances of the lens from the middle of the mirror and of the middle of the mirror from the bottom of the larger box.

The lens being turned towards the prospect would form a picture of it, nearly at its focus; but the rays being intercepted by the mirror will form the picture as far before the surface as the focus is behind it, *i. e.* at the bottom of the larger box, a communication being made between the boxes by the vacant space Q O. The draughtsman then putting his head and hands into the box through the open side, D C, and drawing a curtain round to prevent the admission of the light, which would disturb the operation, may trace a distinct outline of the picture that appears on the bottom of the box.

There is another kind of camera obscura, constructed thus. In the extremity of the arm, P Q, fig. 3, that extends from the side of a small square box, B L, is placed a double convex lens, whose axis is inclined in an angle of 45° to a plane mirror B O: the focal length of the lens is equal to its distance from the side of the box O T; therefore when the lens is turned towards the illuminated prospect it would project the image on the side OT, if the mirror were removed, but this will reflect the image to the side M L, which is as far distant from the middle of the mirror, as this is from the side O T; it is there received on a piece of glass, rough at the upper side and smooth at the lower, and appears in its proper colours on the upper side of the plate. It is evident that in each of these instruments the image is inverted with respect to the object.

M S is a lid to prevent the admission of light during the delineation of the picture, and others for the same purpose are applied to the sides M R and N L.

Dr. Wollaston has recently invented a portable instrument for drawing in perspective, to which he has given the name of camera lucida.

The instrument, as represented in the figures, may be used either with the small round glass turned up in front, fig. 4, or with the larger glass turned up level underneath the instrument, fig. 5, *(seen from above.)* But those who are short-sighted can only use the former, and persons that are long-sighted must use the latter.

The prism is next to be turned upon its pin, till the transparent rectangular face be placed opposite to the objects to be delineated, when the upper black surface of the eye-piece E, will be on the top of the instrument; and through the aperture in this, the artist is to look perpendicularly downwards at his paper.

The black eye-piece E, is moveable, and, in ordinary circumstances is to be in such a position, that the edge of the small transparent part at the back of the prism shall intercept about half the eye-hole. The artist then, looking through the eye-hole directly downwards at his paper, should see the object he wishes to draw, apparently distributed over the paper. For, since his eye is larger than the eye-hole, he sees through both halves of the hole at the same time, without moving his head. He sees the paper through the nearer half, and sees the objects at the same time through the farther half, apparently in the same direction, by means of reflection, through the prism.

The position of the EYE-HOLE, is the circumstance, above all others, necessary to be attended to in adjusting the camera lucida for use; for on the due position of this hole depends the possibility of seeing both the pencil and the objects distinctly at the same time

If the eye-hole be moved, so that nearly the whole of its aperture be over the paper, and a very small portion over the prism, then the pencil and paper will be very distinctly seen; but the objects to be delineated, very dimly. If, on the other hand, the aperture be mostly over the prism, and but a small portion over

the paper, then the objects will be seen distinctly, but the pencil and paper will be very faint. But there will always be an intermediate position (varying according as the objects or the paper happen to be most illuminated) in which both will be sufficiently visible for the purpose of delineation, though not quite so clear as to the naked eye. This intermediate position is easily found with a little practice.

In copying drawings, the copy will be larger or smaller than the original, according as the prism is more or less distant from the paper than it is from the drawing to be copied. Thus, if the drawing be two feet from the prism, and the paper only one foot, the copy will be half the size of the original. If the drawing be at one foot, and the paper three feet distant, the copy will be three times as large as the original; and so for all other distances.

The magic lantern is an optical instrument invented by Athanasius Kircher, the use of which is to magnify small paintings on glass. The construction and use of this instrument will be seen by inspecting fig. 6. A B C D represents a tin lantern, from one side of which there proceeds the square tube *b n k l m c*, consisting of two parts: the outermost of which *n k l m*, slides over the other, so, that the whole tube may be lengthened or shortened by that means. In the end of the arm *n k l m*, is fixed a convex lens, *k l*; about *d e* there is an opening for admitting an object as *d e*, painted in dilute and transparent colours, on a plane of thin clear glass, which object is there placed in an inverted position A single or double convex lens *b h c* is employed for casting the light from the flame of the candle or lamp *a*, very strongly on the picture *d e*. If the object *d e* be placed further from the lens *k l* than its focus, a distinct image of the object will be projected by the glass *k l* upon the opposite white wall or screen F H, at *f g*, and it will be in an erect position.

The apartment in which the exhibition is made must be completely darkened. To increase the light a concave mirror O P is generally placed behind the lamp, having the flame as nearly as possible in its focus.

The exhibition called the phantasmagoria differs from the magic lantern only in the following particulars, *viz*, the sliders are made perfectly opaque except where the figures are introduced; and the screen on which the images are thrown is placed between the lantern and the spectators.

Various methods of preparing muslin for these screens have been tried; but the best, and by far the cheapest is that of simply dipping it in clean water before it is used, which renders it beautifully transparent. The phantasmagoria is finely adapted for exhibiting telescopic views of the heavenly bodies, for which purpose it is much used by public lecturers. A description of a very improved phantasmagoria may be seen in Dr. Young's **Lectures** on *Natural Philosophy*, vol. I. p. 426, 785.

Of the Rainbow and other phenomena of Light.

Since the rays of light are found to be decompounded by refracting surfaces, we can no longer be surprised at the changes produced in any object by the intervention of another. The vivid colours which gild the rising or the setting sun, must necessarily differ from those which adorn its noon-day splendour. There must be the greatest variety which the liveliest fancy can imagine. The clouds will assume the most fantastic forms, or will lour with the darkest hues, according to the different rays which are reflected to our eyes, or the quantity absorbed by the vapours in the air. The ignorant multitude will necessarily be alarmed by the sights in the heavens; by the appearance at one time of three, at another of five suns; of circles of various magnitudes round the sun or moon; and thence conceive that some fatal change must take place in the physical or the moral world, some fall of empires or tremendous earthquake: while the optician contemplates them merely as the natural and beautiful effects produced by clouds or vapour in various masses upon the rays of light.

One of the most beautiful and common of these appearances deserves particular investigation, as, when this subject is well understood, there will be little difficulty in accounting for others of a similar nature, dependent on the different refrangibility of the rays of light. Frequently when our backs are turned to the sun, and there is a shower either around us or at some distance before us, a bow is seen in the air, adorned with all or some of the seven primary colours. The appearance of this bow, in poetical language called the iris, and in common language the rainbow, was an inexplicable mystery to the ancients; and, though now well understood, continues to be the subject of admiration to the peasant and the philosopher.

We are indebted to Sir Isaac Newton for the explanation of this appearance; and by various easy experiments we may convince any man that his theory is founded on truth. If a glass globe is suspended in the strong light of the sun, it will be found to reflect the different prismatic colours exactly in proportion to the position in which it is placed; in other words, agreeably to the angle which it forms with the spectator's eye and the incidence of the rays of light. The fact is, that innumerable pencils of light fall upon the surface of the globe, and each of these is separated as by a prism. To make this matter still clearer, let us suppose the circle B A W, fig. 7, to represent the globe, or a drop of rain, for each drop may be considered as a small globe of water. The red rays, it is well known, are least refrangible; they will therefore be refracted, agreeably to their angle of incidence, to a certain point A in the most distant part of the globe; the yellow, the green, the blue, and the purple rays, will each be refracted to another point. A part of the light, as refracted, will be transmitted, but a part also will be reflected; the red rays at the point A, and the others at certain other points, agreeably to their angle of refraction.

It is very evident that if the spectator's eye is placed in the direction of M W, or the course of the red-making rays, he will only distinguish the red-colour; if in another situation, he will see only by the yellow rays; in another by the blue, &c. but as in a shower of rain there are drops at all heights and all distances, all those that are in a certain position with respect to the spectator will reflect the red rays, all those in the next

station the orange, those in the next the green, &c

To avoid confusion let us imagine only three drops of rain, and three degrees of colours in the section of a bow, fig. 8. It is evident that the angle C E P is less than the angle B E P, and that the angle A E P is the greatest of the three. This largest angle then is formed by the red rays, the middle one consists of the green, and the smallest is the purple. All the drops of rain therefore, that happen to be in a certain position to the eye of the spectator, will reflect the red rays, and form a band or semicircle of red; those again in a certain position will present a band of green, &c. If he alters his station, the spectator will still see a bow, though not the same bow as before; and if there are many spectators they will each see a different bow, though it appears to be the same.

There are sometimes seen two bows, one formed as has been described, the other appearing externally to embrace the primary bow, and which is sometimes called a secondary or false bow, because it is fainter than the other; and what is most remarkable is, that in the false bow the order of the colours appears always reversed.

In the true or primary bow we have seen that the rays of light arrive at the spectator's eye after two refractions and one reflexion: in the secondary bow the rays are sent to our eyes after two refractions and two reflexions, and the order of the colours is reversed, because in this latter case the light enters at the inferior part of the drop, and is transmitted through the superior.

Thus fig. 9, the ray of light which enters at B is refracted to A, whence it is reflected to P, and again reflected to W, where, suffering another refraction, it is sent to the eye of the spectator. The colours of this outer bow are fainter than those of the other, because, the drop being transparent, a part of the light is transmitted, and consequently lost, at each reflection.

The phenomenon assumes a semicircular appearance, because it is only at certain angles that the refracted rays are visible to our eyes. The least refrangible, or red rays, make an angle of 42 degrees two minutes, and the most refrangible, or violet rays, an angle of 40 degrees, 47 minutes. Now if a line is drawn horizontally from the spectator's eye, it is evident that angles formed with this line, of a certain dimension in every direction, will produce a circle; as will be evident by only attaching a cord of a given length to a certain point, round which it may turn as round its axis, and in every point will describe an angle with the horizontal line of a certain and determinate extent.

Let H O, for instance, fig. 9, represent the horizon, B W a drop of rain at any altitude, S B a line drawn from the sun to the drop, which will be parallel to a line S M drawn from the eye of the spectator to the sun. The course of part of the decompounded ray S B may be first by refraction from B to A, then by reflexion from A to W, lastly by refraction from W to M. Now all drops which are in such a situation that the incident and emergent rays S B, M W, produced through them make the same angle S N M, will be the means of exciting in the spectators the same idea of colour. Let M W turn upon H O as an axis, till W meets the horizon on both sides, and the point W will describe the arc of the circle: and all the drops placed in its circumference will have the property we have mentioned, of transmitting to the eye a particular colour. When the plane H M W A is perpendicular to the horizon, the line M W is directed to the vertex of the bow, and WK is its altitude.

This altitude depends on two things, the angle between the incident and emergent rays, and the height of the sun above the horizon; for since S M is parallel to SN, the angle S N M is equal to N M I: but S M H, the altitude of the sun, is equal to K M I; therefore the altitude of the bow W M K, which is equal to the difference between W M I and K M I, is equal to the difference between the angles made by the incident and emergent rays and the altitudes of the sun.

The angle between the incident and emergent rays is different for the different colours, as was already intimated; for the red, or least refrangible, rays, it is equal to 42° 2′; for violet, or most refrangible, it is equal to 40° 17′; consequently when the sun is more than 40° 2′ above the horizon, the red colour cannot be seen; when it is above 40° 17′ the violet colour cannot be seen.

The secondary bow is made in a similar manner; but the sun's rays suffer, in this case, two reflexions within the drop. The ray S B, fig. 9, is decompounded at B; and one part is refracted to A, thence reflected to P, and from P reflected to W, where it is refracted to M. The angle between the incident and emergent rays S M N is equal as before to N M I; and N M K, the height of the bow, is equal to the difference between the angle made by the incident and emergent rays and the height of the sun. In this case the angle S N M, for the red rays is equal to 50° 7′, and for the violet rays it is equal to 54° 7′; consequently the upper part of the secondary bow will not be seen when the sun is above 54° 7′ above the horizon, and the lower part of the bow will not be seen when the sun is 50° 7′ above the horizon.

In the same manner innumerable bows might be formed by a greater number of reflexions within the drops; but as the secondary is so much fainter than the primary, that all the colours in it are seldom seen, for the same reason a bow made with three reflections would be fainter still, and in general, altogether imperceptible. Since the rays of light, by various reflexions, are thus capable of forming by means of drops of rain, the bows which we so frequently see in the heavens, it is evident that there will be not only solar and lunar bows, but that many striking appearances will be produced by drops upon the ground, or air on the agitated surface of the water. Thus, a lunar bow will be formed by rays from the moon effected by drops of rain; but as its light is very faint in comparison with that of the sun, such a bow will very seldom be seen, and the colours of it, when seen, will be faint and dim.

The marine or sea-bow is a phenomenon sometimes observed in a much agitated sea; when the wind, sweeping part of the top of

waves, carries them aloft, so that the sun's rays, falling upon them, are refracted, &c., as in a common shower, and paint the colours of the bow.

Rohault mentions coloured bows on the grass formed by the refraction of the sun's rays in the morning dew.

Dr. Langwith, indeed, once saw a bow lying on the ground, the colours of which were almost as lively as those of the common rainbow. It was extended several hundred yards. It was not round, but oblong, being, as he conceived, the portion of an hyperbola.

The drops of rain descended in a globular form, and thence we can easily account for the effects produced by them on the rays of light: but in different states of the air, instead of drops of rain, vapour falls to the earth in different forms of sleet, snow, and hail. In the two latter states there cannot be a refraction of the rays of light; but in the former state, when a drop is partly in a congealed and partly in a fluid form, the rays of light will be differently affected, both from the form of the drop and its various refracting powers.

The halo, or corona, is a luminous circle surrounding the sun, the moon, a planet, or a fixed star. It is sometimes quite white, and sometimes coloured like the rainbow. Those which have been observed round the moon or stars are but of a very small diameter; those round the sun are of different magnitudes, and sometimes immensely great. When coloured, the colours are fainter than those of the rainbow, and appear in a different order, according to their size. In those which Sir Isaac Newton observed in 1692, the order of the colours from the inside next the sun, was in the innermost blue, white, red; in the middle purple, blue, green, yellow, pale red; in the outermost pale blue, and pale red. Huygens observed one red next the sun, and pale blue at the extremity. Mr. Weidler has given an account of one yellow on the inside, and white on the outside. In France one was observed, in which the order of the colours was white, red, blue, green, and a bright red on the outside.

Artificial coronas may be made in cold weather, by placing a lighted candle in the midst of a cloud of steam; or if a glass window is breathed upon, and the flame of a candle placed at some distance from the window, while the operator is also at the distance of some feet from another part of the window, the flame will be surrounded with a coloured halo.

The parhelia, or mock suns, are the most splendid appearances of this kind.

The parhelia generally appear about the size of the true sun not quite so bright, though they are said sometimes to rival their parent luminary in splendour. When there are a number of them, they are not equal to each other in brightness. Externally they are tinged with colours like the rainbow. They are not always round; and have sometimes a long fiery tail opposite the sun, but paler towards the extremity. Dr. Haller observed one with tails extending both ways. Mr. Weidler saw a parhelion with one tail pointing up, and another downwards, a little crooked; the limb which was farthest from the sun being of a purple colour, the other tinged with the colours of the rainbow.

Coronas generally accompany parhelia: some coloured, and others white. There is also, in general, a very large white circle, parallel to the horizon, which passes through all the parhelia; and, if it was entire would go through the centre of the sun; sometimes there are arches of smaller circles concentric to this, and touching the coloured circles which surround the sun; they are also tinged with colours, and contain other parhelia.

One of the most remarkable appearances of this kind was that which was observed at Rome by Scheiner, as intimated above; and this may serve as a sufficient instance of the parhelion.

This celebrated phenomenon is represented in fig. 10, in which A is the place of the observer, B his zenith, C the true sun, and A B a plane passing through the observer's eye, the true sun, and the zenith. About the sun C there appeared two concentric rings, not complete, but diversified with colours. The lesser of them, D E F, was fuller, and more perfect; and though it was open from D to F, yet those ends were perpetually endeavouring to unite, and sometimes they did so. The outer of these rings was much fainter, so as scarcely to be discernible. It had, however, a variety of colours, but was very inconstant. The third circle, K L M N, was very large, and entirely white, passing through the middle of the sun, and every where parallel to the horizon. At first this circle was entire; but towards the end of the phenomenon it was weak and ragged so as hardly to be perceived from M towards N.

In the intersection of this circle and the outward iris G K I, there broke out two parhelia, or mock suns, N and K, not quite perfect, K being rather weak, but N shone brighter and stronger. The brightness of the middle of them was something like that of the sun; but towards the edges they were tinged with colours like those of the rainbow, and they were uneven and ragged. The parhelion N was a little wavering; and sent out a spiked tail N P, of a colour somewhat fiery, the length of which was continually changing.

The parhelia at L and M, in the horizontal ring, were not so bright as the former, but were rounder, and white, like the circle in which they were placed. The parhelion N disappeared before K; and while M grew fainter, K grew brighter, and vanished the last of all.

It is to be observed further, that the order of the colours in the circles D E F, G K N, was the same as in the common halos, namely, red next the sun; and the diameter of the inner circle was also about 45°, which is the usual size of a halo.

Parhelia have been seen for one, two, three, and four hours together; and in North America they are said to continue some days, and to be visible from sun-rise to sun-set. When they disappear it sometimes rains, or snow falls in the form of oblong spiculæ.

Mr. Wales says, that at Churchill, in Hudson's-bay, the rising of the sun is always preceded by two long streams of red light. These rise as the sun rises; and, as they grow

longer, begin to bend towards each other, till they meet directly over the sun, forming there a kind of parhelion, or mock-sun.

These two streams of light, he says, seem to have their source in two other parhelia which rise with the true sun; and in the winter season, when the sun, never rises above the haze or fog which he says is constantly found near the horizon all these accompany him the whole day, and set with him in the same manner as they rise. Once or twice he saw a fourth parhelion under the true sun; but this, he adds, is not common.

The cause of these is apparently the reflection of the sun's light and image from the thick and frozen clouds in the northern atmosphere, accompanied also with some degree of refraction.

OR, in heraldry, denotes yellow, or gold-colour. See HERALDRY.

ORANGE. See CITRUS.

ORBICULARIS. See ANATOMY.

ORBIT. See ASTRONOMY.

ORCHARD, a plantation of fruit-trees. In planting an orchard, great care should be taken that the soil is suitable to the trees planted in it; and that they are procured from a soil nearly of the same kind, or rather poorer than that laid out for an orchard. As to the situation, an easy rising ground, open to the south-east, is to be preferred. Mr. Miller recommends planting the trees fourscore feet asunder, but not in regular rows; and would have the ground between the trees plowed, and sown with wheat and other crops, in the same manner as if it was clear from trees; by which means the trees will be more vigorous and healthy, will abide much longer, and produce better fruit. If the ground has been pasture, the green sward should be plowed in the spring before the trees are planted; and if it is suffered to lie a summer fallow, it will greatly mend it, provided it is stirred two or three times to rot the grass, and prevent the growing of weeds. At Michaelmas it should be plowed pretty deep in order to make it loose for the roots of the trees, which if the soil is dry, should be planted in October; but if it is moist, the beginning of March will be a better season.

If several sorts of fruit-trees are to be planted on the same spot, you should observe to plant the largest-growing trees backwards, and so proceed to those of less growth, continuing the same method quite through the whole plantation; by which means the sun and air will more easily pass through the whole orchard. When you have planted the trees, you should support them with stakes, to prevent their being blown out of the ground by the wind; and the following spring, if the season should prove dry, cut a quantity of green turf, and lay it about the roots, with the grass downwards; by which means a great expence of watering will be saved, and after the first year they will be out of danger. Whenever you plow the ground betwixt these trees, you must be careful not to go too deep amongst their roots which would greatly damage the trees, but if you do it cautiously, your stirring the face of the ground will be of great service to them; though you should observe never to sow too near the tree, nor to suffer any great rooting weeds to grow about them; because this would starve them, by exhausting the goodness of the soil, which every two or three years should be mended with dung or other manure. These trees, after they are planted out, will require no other pruning besides cutting off their bad branches, or such as cross each other.

ORCHIS, *fool-stones*, a genus of the gynandria diandria class of plants, the corolla of which is of a corniculated form; and its fruit is an oblong unilocular capsule, containing numerous scobiform seeds

The essential character is, nect. a horn or spur behind the flower. There are 50 species of this genus, which exceedingly resembles the ophrys.

This plant flourishes in various parts of Europe and Asia, and grows in our country spontaneously, and in great abundance. It is assiduously cultivated in the East; and the roots of it form a considerable part of the diet of the inhabitants of Turkey, Persia, and Syria. From it is made the alimentary powder called salep; which prepared from foreign roots, is sold at five or six shillings per pound, though it might be furnished by ourselves at a sixth part of that price, if we chose to pay any attention to the culture of this plant. The orchis mascula is the most valued for this purpose. A dry, and not very fertile soil, is best adapted to its growth.

ORDEAL, a form of trial, or of discovering innocence or guilt, formerly practised over almost all Europe, and which prevailed in England from the time of Edward the Confessor, till it was abolished by a declaration of Henry III. It was called purgatio vulgaris, or judicium in opposition to bellum, or combat, the other form of purgation.

In England an offender, on being arraigned, and pleading not guilty, had it in his choice to put himself upon God and his country; that is, upon the verdict of a jury; or upon God alone, on which account it was called the judgment of God, it being presumed that God would deliver the innocent. The more popular kinds of ordeal were those of red-hot iron and water: the first for freemen and people of fashion, and the last for peasants. Fire ordeal was performed either by taking up in the hand a piece of red-hot iron, of one, two, or three pounds, weight; or else by walking barefoot and blindfolded over nine red-hot ploughshares, laid at equal distances: and if the party escaped unhurt he was adjudged innocent, if not he was condemned as guilty. Water ordeal was performed either by plunging the bare arm up to the elbow in boiling water, and escaping unhurt thereby; or by casting the person suspected into a river or pond of water; and if he floated therein, without any action of swimming, it was deemed an evidence of his guilt; but if he sunk he was acquitted.

ORDER. See ARCHITECTURE.

ORDERS, or ORDINATION. No person shall be admitted to the order of deacon under 23 years of age; nor to the order of priest unless he is 24; and none shall be ordained without a title, that is, a nomination to some cure or benefice, and he shall have a testimonial of his good behaviour, for three years past, from three clergymen; and the bishop shall examine him, and if he sees cause may refuse him. And before he is ordained he shall

take the oath of allegiance and supremacy before the ordinary, and subscribe the 39 articles.

ORDINARY, in common and canon law, is one who has ordinary or immediate jurisdiction in ecclesiastical causes in such a place. In which sense archdeacons are ordinaries, though the appellation is more frequently given to the bishop of the diocese, who has the ordinary ecclesiastical jurisdiction. The archbishop is the ordinary of the whole province, to visit and receive appeals from inferior judicatures.

ORDINATES, or **Ordinate Applicates**, in geometry, are parallel lines terminating in a curve, and bisected by a diameter.

ORDNANCE, a general name for sorts of great guns used in war.

Ordnance, *office of*, an office kept within the Tower of London, which superintends and disposes of all the arms, instruments, and utensils of war, both by sea and land, in all the magazines, garrisons, and forts, in Great Britain.

ORES, metallic. This class comprehends all the mineral bodies, composed either entirely of metals, or of which metals constitute the most considerable and important part. It is from the minerals belonging to this class that all metals are extracted; for this reason they have obtained the name of ores.

As the metals at present known amount to 23, we shall divide this class into 23 orders, allotting a distinct order for the ores of every particular metal.

Metals exist in ores in one or other of the four following states: 1. In a metallic state, and either solitary or combined with each other. 2. Combined with sulphur. 3. In the state of oxides. 4. Combined with acids. Each order therefore may be divided into the four following genera:

1. Alloys. 3. Oxides.
2. Sulphurets. 4. Salts.

It must be observed, however, that every metal has not hitherto been found in all these four states, and that some of them are hardly susceptible of them all.

ORGAN, a wind-instrument blown by bellows, and containing numerous pipes of various kinds and dimensions, and multifarious tones and powers. Of all musical instruments this is the most proper for the sacred purpose to which it is most generally applied in all countries wherever it has been introduced. Its structure is lofty, elegant, and majestic; and its solemnity, grandeur, and rich volume of tone, have justly obtained it an acknowledged pre-eminence over every other instrument.

An organ, when complete, is of threefold construction, and furnished with three sets of keys; one for what is called the great organ, and which is the middle set; a second (or lower set) for the choir organ; and a third (or upper set) for the swell. In the great organ, the principal stops are the two diapasons, the principal, the twelfth, the fifteenth, the sesquialtra, the mixture or furniture, the trumpet, the clarion, and the cornet. The choir organ usually contains the stops diapason, the dulciana, the principal, the flute, the twelfth, the bassoon, and the vox humana. The swell comprises the two diapasons, the principal, the hautboy, trumpet, and cornet.

The church-organ consists of two parts; the main body, called the great organ, and the positive or little organ, which forms a small case or buffet, commonly placed before the great organ. The size of an organ is generally expressed by the length of its largest pipe: thus they say, an organ of 8, 16, 32 feet, &c. The organ in the cathedral church at Ulm in Germany is 93 feet high and 28 broad; its largest pipe is 13 inches diameter, and it has 16 pair of bellows.

ORGANIC REMAINS, or, as the science is called by some, *oryctology*. This department of natural history has of late excited an unprecedented degree of attention among the scientific; and, to the inquiring mind, does undoubtedly throw open, as it were, a new world of matter for contemplation of the most gratifying description. To pretend to enter at large on this subject, would in the present case appear presumptuous; we shall therefore merely present our readers with an abstract of it from the writings of the author of a well-known work on "The Organic Remains of a former World."

This subject, then, has reference to all those animal and vegetable substances which are dug out of the earth in a mineralized state.

In the following slight sketch of the history of these substances, it will be seen, that the remarkable situations in which they have been found, and the extraordinary changes which they have undergone, have led to the adoption of various contradictory and absurd notions respecting their nature and origin: which have been corrected, as just ideas have been obtained respecting the formation of the earth itself. Xenophanes, more than 400 years before Christ, was led to the belief of the eternity of the universe, by discovering the remains of different marine animals imbedded in rocks, and under the surface of the earth. Herodotus ascertained the existence of fossil shells in the mountains of Egypt, and was thereby induced to conclude, that the sea must have once covered those parts. In the pyramids of Egypt, mentioned by this author, and which had been built at so early a period that no satisfactory accounts could be derived from tradition respecting their erection, the stones were found to contain the remains of marine animals, and particularly of such as exist no longer in a recent state, and differ essentially from all known animals. These were supposed by Strabo, who saw the fragments of these stones lying around the pyramids, to be the petrified remains of the lentils which had been used for food by the workmen. Eratosthenes, Xanthus of Lydia, and Strabo, have all noticed and variously commented upon the existence of animal remains thus wonderfully preserved. In the works of Pliny, many fossil bodies are mentioned, particularly the bucardia, resembling an ox's heart, but which was, perhaps, a cast formed in a bivalve shell; glossopetra, bearing the form of a tongue, and supposed to fall from the moon, when in its wane; hammites, resembling the spawn of fish; horns of ammon, resembling, in form, the ram's horn; lepidotes, like the scales of fishes; meconites, bearing a resemblance to the seeds of poppies; brontia, to the head of a tortoise; spongites, to sponge; phycites, to sea-weeds or rushes, &c.

The parts of vegetables confined in subterranean situations suffer, according to cir-

cumstances, either a complete resolution of composition, the lighter parts becoming volatilized, whilst the more fixed remain, and form the substance which is termed mould (*humus*,) or, as is supposed by Mr. Parkinson, it passes through another process, which he considers as fermentative, and becomes bituminous. Wood, thus changed, is called lignum fossile bituminosum, surturbrand, and Bovey coal. By the extension of this process, the same author supposed, that the substances termed bitumens, (naphtha, petroleum, and asphaltum,) are formed. To the same process he also attributes the formation of amber, of which however no proof appears. That jet, cannel coal, and the common coal employed in domestic uses, have had a vegetable origin, is rendered highly probable, from the frequency with which they manifest the impressions of various vegetable bodies.

Thus, perhaps, the formation of the bituminous fossils may be satisfactorily explained; but by far the greater number of vegetable fossils are of a lapideous nature, and necessarily owe their formation to very different processes; which the same author supposes are, in general, preceded by the process by which bitumen is formed. Many bodies, which are evidently of vegetable origin, may be now found existing in a lapideous, either calcareous or silicious, state; and many others are found possessing certain marks of the presence of some metallic substance.

Various parts of trees and plants (*phytolithi*) are found in a mineralized state. Not only fossil wood (*lithoxylon*,) as has been just noticed, but the leaves (*lithopylla* or *lithobiblia*,) and fruits (*carpolithi*) of different trees or plants are thus found. Of the woods, several, from their form and texture, have been supposed to have been originally oak, willow, and such trees as now exist in a recent state; whilst others differ, in both these respects, from any species of wood which is now known.

The impressions of the stalks and leaves of plants are very frequently found in many parts of the world, in lofty mountains, as well as at considerable depth below the surface; and not only the impressions, but the substance itself of different vegetables are also thus found; but in no situation more frequent than in the neighbourhood of coal mines.

In general these vegetable remains are found deposited in lamina, in the schistose strata which accompany the coal; but the most perfect remains are commonly found in roundish nodular masses of ferruginous clay, which abound in the strata accompanying the coal. These are commonly termed catsheads by the workers of the coal mines, and contain pieces of fern, &c. very few, indeed, of which are found to agree with any known recent plants. One of these plants, preserved in coal slate, is shewn, plate XL and XLI, fig. I.

The remains of fruits are, perhaps, no where found so abundantly as in the Isle of Sheppey, where they are dug up in great variety; very few, however, being found which agree with any known recent fruits. Where any resemblance appears, it is with fruits which only grow in the warm Asiatic regions. Fig. 2, represents a fossil fruit which was found in the cliff of Sheppey.

Fossil roots of plants or trees are very rarely found; a circumstance not very easily explained; since they possess (especially the roots of trees) that degree of solidity which appears to be favourable to the process of petrifaction. From the want of this necessary property it undoubtedly is, that we possess so few remains of tender flower leaves, and none of pulpy fruits.

From the same cause, the great proneness to decomposition, the number of animal fossils is considerably limited: those substances being only preserved in a mineralized state which originally possessed a considerable degree of solidity; such are the bones, teeth, horns, shells, scales, &c. The animal, however, far exceeds the vegetable kingdom in the number and variety of fossils which it yields, as well as in the distinctness of form, and excellency of preservation, in which they are found.

Adopting in a great measure the arrangement of Waller, we shall commence our examination of the animal fossils with those which have derived their origin from corals. These fossils are, of course, merely the remains of the dwellings which have been formed by the various coral insects, and which are so frequently found in the cabinets of the curious.

Immediately on commencing this examination. we are struck with a similar want of agreement between the recent and fossil corals, with that which has been noticed between recent and fossil vegetables. Of the genus *tubipora* it does not appear, at least by the observations made in Mr. Parkinson's second volume of "The Organic Remains of a former World," that a single species which is known recent has been found as a fossil. Several fossil species are, however, described, of which nothing similar is known in a recent state. The most striking of these is the *tubipora catenularia*, or chain coral, the surface of which, in consequence of the tubes being in contact at their sides, has frequently a very curious reticulated or catenulated appearance. Fig. 4, represents this fossil in its usual state: and at fig. 5 is shewn the appearance of a transverse section. *Tubipora fascicularis*, *T. stellata*, *T. repens*. and *T. strues*, which have been described by different authors, and which are unlike to any known recent tubipore, give reason for supposing that the number of species of fossil tubipores exceeds that of the recent species.

The fossil madrepores are not less rich in variety, nor less comparatively numerous, than the fossils of the preceding genus. The forms of several species of the fossil madrepores do frequently approach to those of the different recent species; but in a considerable number of the fossil madrepores no resemblance is discoverable, except in their stelliform openings, with any recent coral. The madrepores consisting of a single star appear to be much more numerous in a mineral than in a recent state.

It would be useless to attempt, in this sketch, to specify the considerable variety of fossil madrepores formed of aggregated circular stars, and which have been designated as astroites, &c. Those which are composed of angulated stars are, perhaps, not so numerous: many of these, however, are very different in their appearance from those which are known in a recent state. The one most known in

these islands is the lithostrotion, sive basaltes striatus et stellatus, of Llwyd. The exact union of the sides of the polygons giving a tolerably correct idea of minute basaltes.

The millepora do not appear to be so frequently found in a mineral as in a recent state.

Of the genus isis, one species only appears to be known as a fossil. This species was first described by Scilla, who at first conjectured it to be the leg-bone of some animal. Specimens are frequently found in the Calabrian mountains, and have lately been also found in some parts of Wiltshire. Of the genus cellepora, antipathes, and gorgonia, fossil specimens appear to be rather uncommon.

The corallo fungitæ of Waller are evidently the fossil remains of alcyonia. These have been long described by Volkmann, Scheuchzer, and others, as fossil fruits, and have obtained, from their resemblance to figs, &c. the appellations of ficoides, caricoides, &c.; whilst others of a different form have been named lycoperditæ, fungitæ, pilcati, &c. A fossil alcyonium has even been described by Volkmann and Scheuchzer as a fossil nutmeg. A fossil alcyonium of a conical form is represented, fig. 6.

The encrini and pentacrini have been always, and very properly, considered as the most curious of the fossil zoophytes. The encrinus, fig. 3, possesses the distinguishing character of having its spine, or, as it has been generally called, its tail, composed of cylindrical or orbicular vertebræ, pierced through their centre, and marked with diverging striæ on their articulating surfaces.

The fossil pentacrinus differs from the encrinus, in its vertebræ being of a pentagonal form, and in its arms, fingers, and tentacula being capable of being much more widely spread and extended than are those of the encrinus.

The encrinital vertebræ, fig. 7, *a*, have been hitherto termed trochitæ when separate, and entrochi when connected in a series, fig. 7. The single vertebræ of the pentacrinus have been distinguished as asteriæ, fig. 8, *a*: and when united together they have been termed columnar asteriæ, fig. 8.

Of the asteriæ, or stellæ marinæ, some very few specimens have been found fossil; but they occur very rarely.

The fossil echini are very numerous, upwards of forty species, known only as fossils, being enumerated by the illustrious Linnæus.

An attempt to particularize the various species of fossil shells which have been found, would require a large volume: all that can be here done is to notice some of those which totally differ from any which exist in a recent state, and to offer some remarks on those which approximate, or are similar to some of the species which are known in a recent state.

With respect to the state in which fossil shells are found, it is necessary to remark, that, in some situations, shells which have been buried for ages, by the natural changes which the surface of the earth has undergone, are found very little changed, except from the loss of colour, and having been rendered extremely fragile; that in other situations the substance of the shell has been so injured as to be reduced to very small fragments, and even to a fine powder, leaving in some instances a stony, correctly moulded, cast of the cavity of the shell; that very frequently the substance of the shell is entirely altered, having become a calcareous stone, or a silicious or pyritous mass, and that the shells of a former world are frequently found in masses of marble, which is called lumachelli, or shelly marble.

Of the multivalves, the chiton does not appear to have been found in a mineralized state; and although several species of lepas have been found in a mineral state, they are by no means frequent fossils. Lepas anserifera is said to have been found fossil, as well as lepas diadema; these must, however, be exceedingly rare fossils. Fossil shells of the pholas are by no means common; the pholas crispata has been, however, found among the Harwich fossils. Fossil bivalves are very common fossils; they are, as might be expected, very seldom found in pairs, except when united by a lapideous mass, which prevents the examination of their hinge, or their internal structure, which in many fossil shells are objects highly worthy of examination.

Anomia lacunosa, fig. 9, is one of the most abundant of these species. They are found in considerable quantities in different parts of England. Anomia terebrâtula, fig. 10, is another fossil of this genus, which exists in different counties in this island, in great abundance.

Of the genus mytilus several species are known as fossils, some of which approach very near to those which are known recent: one in particular appears to differ very little indeed from mytilus modiolus. No fossil shell appears yet to have been found which can with certainty be placed under the genus argonauta. But of the genus nautilus, specimens are very frequent, fig. 11.

There are none of the fossil shells, except perhaps the anomiæ, which can vie in the variety of their species with the cornu ammonis. The cornua ammonis were formerly called serpent-stones; the appearance which they yield of a serpent coiled having led the vulgar to consider them as petrified serpents, fig. 12.

The fossil cones are very few when compared with the numerous species known in a recent state; the same may be also said of the cypræa. In both these genera the species are mostly made out more from the colour and the markings of the shells, than from the peculiarities of their form; but in the fossil shells the colours no longer exist, and of course the species in these can very seldom be presumed. The fossil volutes, as far as can be judged from their form alone, differ generally from the recent species. With respect to the genus buccinum, strombus, and murex, the number of species of the fossil shells do not appear to equal those which are known in a recent state. This is the case also, in a still greater degree, with the genus trochus. The fossil shells of the genus turbo are pretty numerous, and some of them very closely resemble those of known recent species. One fossil shell of this genus is very remarkable for its vast size, being upwards of a foot in length. The cast of another species is so large as to weigh four or five pounds.

The orthoceratites, a lapidified conical or cylindrical chambered shell, the septa dividing

the chambers of which are perforated like those of the nautilus, is a genus of which not a species is known in a recent state, excepting the microscopic specimens found by Plancus in the sand of the Riminian shore. Authors have divided them into those which are straight, fig. 13, and those which have a spiral termination, the latter of which are considered as fossil-shells of the nautilus lituus.

The belemnite, fig. 14, is a spathose radiated stone, generally conical, but sometimes possessing a fusiform figure, and contains, in an appropriate cavity at its larger end, a smaller calcareous body (*alveolus*) which has evidently been a concamerated shell, the septæ of which are pierced like those of the preceding fossil. Among the fossil-shells which can only be here enumerated, are the rare tuberculated turrilite, or chambered turbinated shell, the orbulites, planulites, and baculites of Lamarck. Insects of the smaller kinds are seldom found in a fossil state, the smallness of their size and the delicacy of their structure most probably preventing their preservation. The one, which is generally found in the most perfect condition, is that generally known to us as the Dudley fossil, from its being found in the neighbourhood of Dudley, in Worcestershire, fig. 15.

The remains of lobsters and crabs are frequently found in the isle of Sheppey, and Malta. The remains of different species of these animals are also found in a compressed state in the margaceous and schistous masses of Pappenheim and Oppenheim. The fossil remains of amphibia are very numerous, and supply us with ample exercise for inquiry and admiration. In different parts of England, particularly in Somersetshire and Dorsetshire, the remains of animals apparently of the lacerta genus are frequently found; but are, as far as we are able to judge, really different from any animal which is known to us. But in no part of the world have such exquisitely fine and wonderful remains of animals of this description been found as in St. Peter's Mountain near Maestricht.

The plates of St. Fond, as well as the specimen of professor Camper, shew that these are the remains, indubitably, of an enormous animal, different from any at present known. It must however be observed, that the remains of crocodiles, apparently of the same species which now exist, have also been discovered: part of the head of the Asiatic crocodile was found in very good preservation in the quarries of Altdorff.

Fossil fishes have been found imbedded in calcareous and argillaceous masses, in various parts of Germany, Switzerland, and Italy; but no where in such prodigious numbers as in the mountain named Vestena-Nuova, generally called Monte Bolca, in the Veronese, which extends, in height, a thousand feet above the quarry, in which are found the numerous remains of fish; of which, specimens are to be seen in almost every cabinet of repute in Europe. The remains of fishes, from an inch to upwards of three feet in length, are found in these quarries, and of these several are found whose living analogues are said to exist in the neighbourhood of Japan, and of Brasil, also in Africa and America. The Abbé Fortis is of opinion that the actual descendants of the Veronian fossil-fishes are now to be found in the sea which washes the shores of Otaheite. In Cerigo (Cytherea) Alessano, Lesina, in Dalmatia, Oeningen, Pappenheim, in Aix, and in several parts of France, fossil-fishes are found in very excellent preservation. In England, fossil-fishes are much more rarely found than in France, Germany, or Italy.

The fossil-fish of Vestena Nuova are supposed to prove, from several circumstances, that their privation of life was sudden; some having been found with the head of their prey still in their mouths; and others with the remains of the fish, which they had devoured, still in their stomachs.

The fossil remains of birds are very rarely found, though frequently mentioned, and even described by different authors. Fossils very much resembling the beaks of birds are sometimes found; but these are much more probably parts of fishes. Several of those specimens which have been spoken more positively of, as petrifactions of whole birds, and of their nests, have been merely calcareous incrustations of very modern formation. Bones very much resembling the bones of birds have been found in the calcareous stone of Oxfordshire, and in some parts of France, and of Germany.

The fossil remains of quadrupeds, especially those of the larger kind, are such as must excite the attention and wonder of every curious inquirer in natural history. In various parts of this country have been found the remains of elephants, and of other animals of considerable magnitude. In Ireland have been found the remains of deer, of a size far exceeding any now known; and in Scotland have been found the remains of the elk, as well as those of an enormous animal of the ox kind, but larger than even the urus. In France, Germany, Italy, and indeed in most parts of Europe, remains of large animals have been found, and in both North and South America, the remains of enormous unknown animals have been discovered. According to Pallas, from the Tanais to the continental angle nearest to America, there is hardly a river in this immense space, especially in the plains, upon the shores or in the bed of which have not been found the bones of elephants and of other animals not of that climate. From the mountains by which Asia is bounded, to the frozen shores of the ocean, all Siberia is filled with prodigious bones; the best ivory (fossil) is found in the countries nearest to the arctic circle, as well as in the eastern countries, which are much colder than Europe, under the same latitude; countries where only the surface of the ground becomes thawed during summer.

The number of bones which have been discovered of the rhinoceros is very considerable, not only in Siberia, but in Germany, and in other parts of Europe; and in the opinion of St. Fond, founded not only on the discoveries of Pallas and others, but on his own observations made on the immense collection of Merck, joined with that of the Langrave of Hesse Darmstadt, are of the species with double horns. An entire body of an animal of this species, still possessing the skin, fat, and muscles, has been dug up near the river Willioni, in the eastern part of Siberia, from

under a hill, which is covered with ice the greatest part of the year. St. Fond states, in confirmation of the above opinion, that another head obtained by Pallas from Siberia; one existing in the cabinet of the elector of Manheim, and another in the cabinet of Merck, are all apparently similar to the head of the double-horned rhinoceros of Africa.

Much remains to be ascertained with respect to the fossil remains of elephants, of which considerable numbers have been found in various parts of England, France, Germany, and Italy; but no where so abundantly as in Siberia. In America indeed the remains of an unknown species of this animal are also very abundant. There appear to be only two species of elephants now in existence; one (the Asiatic) being distinguished by its grinders being divided into transverse and nearly parallel plates, and the other (the African) having these plates disposed in lozenge-like forms.

The elephantine remains which have been found in Siberia have been supposed to have belonged to no existing species; for though the teeth are formed of plates disposed parallel to each other, as in the Asiatic, these plates are said to be thinner, and consequently more numerous; but this distinction is by no means established. The remains of elephants discovered in this country seem referable, in most instances, to the Asiatic.

With respect to the elephant whose remains have been found in America, the tooth of which differs essentially from all known fossil or recent species, in having its crown cuspidated and covered with enamel, fig. 16, there exists at present every reason for supposing it to be of a species now extinct. The generally adopted opinion that this animal was of a carnivorous nature is by no means established; but is indeed contradicted by the assertion that the stomach of one of these animals has been found filled with vegetable matter. One of these animals, with its flesh, skin, and hair, has been lately found in Siberia.

The remains of an animal of an enormous size has been found at Paraguay, at no great distance from the river Plata, which being properly arranged, has been formed into a skeleton, and placed in the cabinet of natural history at Madrid. This animal, twelve feet in length, and six in height, is distinguished, as well as by its general form, by the largeness of its claws; on which account, Mr. Jefferson has named it the megalonyx.

In various parts of Scotland, and of France; in Tuscany, the Veronese, and in North America, have been found the fossil remains of some animal which has been supposed to be a variety of the urus of Julius Cæsar, or of the bison. But these horns, which are of very considerable size, appear to have belonged to a different species of animal from any which is at present known. To the fossil remains already mentioned, may be added the animal incognitum of Symore, in Languedoc; the enormous stag, found in the mosses of Ireland; the gigantic tapir, found at the bottom of the black mountains of Languedoc; the bears, of two species, now unknown, found in Bareith; and the numerous animals of unknown species which the admirably indefatigable Cuvier is perpetually discovering, in that mine of fossils, the quarries of gypsum, near Paris.

Of the mineralized remains of man no well attested instance is known. In a cavern, indeed, in Mendip Hills, some human bones have been found, invested with stalactite; these appear to be but comparatively of modern existence. Scheuchzer published an essay describing a supposed skeleton of a man; which was undoubtedly the remains of some large fish.

A view of the forgeoing sketch cannot but shew, that the study of this science must prove a source of the highest gratification to every mind that contemplates the works of nature, for the purpose of obtaining a glimpse of the beauty which they display, and of the power which they manifest. By this science we obtain, not only a knowledge of the peculiar beings which dwelt on this planet in its antediluvian state, but we also acquire a more correct knowledge of the structure of this globe itself. We at the same time discover the strongest proofs of those changes which it has suffered, and which are recorded in the Holy Scriptures; whilst our reverential admiration is excited at this wonderful display of the power and providence of the Almighty Creator.

ORIBASIA, a genus of the monogynia order in the pentandria class of plants, and in the natural method ranking under the 47th order, stellatæ. The corolla is small, tubulated, and monopetalus. The pericarpium is a globular berry, grooved longitudinally: is quinquelocular, and contains one seed. Of this there are six species, all natives of the warmer parts of America, viz. 1. Officinalis; the natives of Guiana make infusions of the leaves and give them in cases of spasmodic asthma. 2. Racemosa. 3. Violacea. 4. Lutea. 5. Paniculata. 6. Longiflora.

ORICHALCUM. See ZINC.

ORIGANUM, *origany* or *majorum*, a genus of the gymnospermia order, in the didynamia class of plants, and in the natural method ranking under the 42d order, verticilatæ. There is a strobilus or cone collecting the calices together. The principal species are two hardy perennials and an annual for the open ground, and five perennials for the green house, viz. 1. The vulgare, or wild majorum. 2. The heracleoticum, or winter majorum.

ORIGENISTS, in church history, a Christian sect in the fourth century, so called from their drawing their opinions from the writings of Origen. The Origenists maintained, that the souls of men had a pre-existent state, that they were holy intelligences, and had sinned in heaven before the body was created; that Christ is only the Son of God by adoption.

ORIGINAL, in the court of king's bench the usual original writ issued in the actions, as for action of trespass upon the case. And this court does not issue originals in actions of debt, covenant, or account, &c. whereas the court of common pleas proceeds by original in all kinds of actions; but to arrest and sue a party to outlawry, it is used in both cases.

ORIOLUS, *oriole*, in ornithology, a genus belonging to the order picæ. The bill in this genus is straight, conic, very sharp pointed; edges cultrated, inclining inwards; mandibles of equal length. Nostrils small, placed at the base of the bill and partly covered. Tongue, divided at the end. Toes three

forward, one backward; the middle joined near the base to the outmost one. These birds are inhabitants of America, except in a few instances; they are a noisy and gregarious, frugivorous, granivorous, and voracious race, very numerous, and often have pessile nests. The several species, which are very numerous, since Mr. Latham describes no less than forty-five, seem to be principally distinguished by their colour.

ORION, in astronomy, a constellation of the southern hemisphere, consisting of thirty-seven stars, according to Ptolemy; of sixty-two according to Tycho; and of no less than eighty, in the Britannic catalogue.

ORNITHOGALUM, *star of Bethlehem*, a genus of the hexandria monogynia class of plants, the corolla whereof consists of six petals, of a lanceolated figure from the base to the middle erect, from thence to the points, plano-patent; they are permanent, but lose their colour; the fruit is a round angulated capsule, formed of three valves, and containing three cells; the seeds are numerous and roundish, the receptacle columnar. There are thirty-five species, all of them herbaceous and perennial, rising from three to six feet high, having stalks terminated with long spikes of hexapetalous, star-shaped, white and yellow flowers.

ORNITHOLOGY, that branch of natural history which considers and describes birds, their natures and kinds, their form, external and internal, and teaches their economy and uses; see AVES: also the several orders and genera in the alphabetical order. Birds are divided, according to the form of their bills, into six orders, viz. *accipitres*, as eagles, vultures, and hawks: *picæ*, as crows, jackdaws, humming-birds, and parrots: *anseres*, as ducks, geese, swans, gulls: *graliæ*, as herons, woodcocks, and ostriches: *gallinæ*, as peacocks, pheasants, turkies, and common fowls; and *passeres*, comprehending sparrows, larks, swallows, &c.

ORNITHORYNCHUS *paradoxus* from New South Wales, a singular quadruped, which has not yet been properly classed in the Linnæan system. The most remarkable circumstance in this curious animal, is the great similarity of its head with that of a duck, which however, is still more striking in its internal structure. From the external form of the scull of this animal, one might be more easily led to conclude that it belonged to such an aquatic bird, than to a creature of the mammalia tribe. Both the jaws are as broad and low as in a duck, and the calvaria has no traces of a suture, as is generally the case in full grown birds. There is likewise a singularity in the cavity of the scull, of which nothing like it is known in any quadruped animals of the mammalia, though there exists something analogous in the class of birds, namely, a considerable bony falx, which is situated along the middle of the os frontis, and the ossa bregmatis. This processus is in general scarcely to be seen in the mammalia, even in those that have a bony tentorium cerebelli. The mandible of this animal is very singular, consisting of a beak, the under part of which has its margin indented as in ducks, and of the proper instrument for chewing that is situated behind, within the cheeks. This has no teeth, nor even the traces of alveoli, but only two broad processes of a peculiar formation on each side, whose undulated superficies fit one another. Dr. Shaw says of the specimen he examined, that it had no teeth, "dentium nulla sunt vestigia." But Sir Joseph Banks informs us that Mr. Home has found in a specimen that belongs to the Society of Natural History at Newcastle, on each side of the jaws, two small and flat molar teeth. The fore part of this anomalous mandible, or the beak, is covered and bordered with a coriaceous skin, in which three parts are to be distinguished: 1. The proper integument of the beak (integumentum rostri.) 2. The labiated margins of it (margines labiales.) 3. A curious edge of the skin of the beak (limbus transversarius.)

ORPHAN. In the city of London there is a court of record established for the care and government of orphans.

ORPIMENT is a fine yellow powder, formed from a solution of the white oxide of arsenic in muriatic acid, to which is added a solution of sulphuretted hydrogen in water. It may also be obtained by subliming arsenic and sulphur by a heat not sufficient to melt them. It is likewise found native in many parts of Germany and Italy, composed of plates that have a considerable degree of flexibility.

ORRERY, a curious machine for representing the motions and appearances of the heavenly bodies. See PLANETARIUM.

ORTHOGRAPHY, that part of grammar which teaches the nature and affections of letters, and the just method of spelling or writing.

ORTHOGRAPHY, in geometry, the art of drawing or delineating the fore right plan of any object, and of expressing the heights or elevations of each part. It is called orthography, from its determining things by perpendicular lines falling on the geometrical plane.

ORTHOGRAPHY, in architecture, the elevation of a building.

ORTHOGRAPHY. See PERSPECTIVE.

OTTOLAN. See EMBERIZA.

ORYZA, *rice*, a genus of the digynia order, in the hexandria class of plants; and in the natural method ranking under the 4th order, gramina. The calyx is a bivalved uniflorous glume; the corolla bivalved, nearly equal, and adhering to the seed. There is but one species, namely, the sativa or common rice. This plant is greatly cultivated in most of the Eastern countries, where it is the chief support of the inhabitants; and great quantities of it are brought into England and other European countries every year, where it is much esteemed for puddings, &c. it being too tender to be produced in these northern countries without the assistance of artificial heat; but from some seeds which were formerly sent to Carolina there have been great quantities produced, and it is found to succeed there as well as in the Eastern countries.

OSCILLATION, in mechanics, the vibration, or reciprocal ascent and descent, of a pendulum. See PENDULUM.

It is demonstrated, that the time of a complete oscillation in a cycloid, is to the time in which a body will fall through the axis of that cycloid, as the circumference of a circle to its diameter; whence it follows, 1. That

the oscillations in the cycloid are all performed in equal times, as being all in the same ratio to the time in which a body falls through the diameter of the generating circle. 2. As the middle part of the cycloid may be conceived to coincide with the generating circle, the time in a small arch of that circle will be nearly equal to the time in the cycloid; and hence the reason is evident, why the times in very little arches are equal. 3. The time of a complete oscillation in any little arch of a circle, is to the time in which a body would fall through half the radius, as the circumference of a circle to its diameter; and since the latter time is half the time in which a body would fall through the whole diameter, or any chord, it follows that the time of an oscillation in any little arch, is to the time in which a body would fall through its chord, as the semicircle to the diameter. 4. The times of the oscillations in cycloids, or in small arches of circles, are in a sub-duplicate ratio of the lengths of the pendulums. 5. But if the bodies that oscillate are acted on by unequal accelerating forces, then the oscillation will be performed in times that are to one another in the ratio compounded of the direct subduplicate ratio of the lengths of the pendulums, and inverse subduplicate ratio of the accelerating forces. Hence it appears that if oscillations of unequal pendulums are performed in the same time, the accelerating gravities of these pendulums must be as their lengths; and thus we conclude, that the force of gravity decreases as you go towards the equator, since we find that the lengths of pendulums that vibrate seconds are always less at a less distance from the equator. 6. The space described by a falling body in any given time, may be exactly known; for finding by experiments, what pendulum oscillates in that time, the half of the pendulum will be the space required, in the duplicate ratio of the diameter of a circle to the circumference.

OSCILLATION, *Centre of.* See CENTRE.

OSIER, a very valuable shrub, of the salix viminales, used principally in basket-making.

OSMAZOME. If cold water which has been digested for a few hours on slices of raw muscular fibre, with occasional pressure, be evaporated, filtered, and then treated with pure alcohol, a peculiar animal principle will be dissolved, to the exclusion of the salts. By dissipating the alcohol with a gentle heat the osmazome is obtained. It has brownish-yellow colour, and the taste and smell of soap. Its aqueous solution affords precipitates, with infusion of nut-galls, nitrate of mercury, and nitrate and acetate of lead

OSMIUM. See CHEMISTRY.

OSSIFICATION. The deposition of calcareous phosphate or carbonate on the soft solids of animal bodies; as in the pineal gland, lungs, liver, &c.

OSTEOLOGY. See ANATOMY.

OSTEOSPERMUM, a genus of the class and order syngenesia polygamia necessaria. "The cal. is simple, in two rows, many-leaved, almost equal; seeds globular, coloured, bony; down none; recept. naked. There are seventeen species, shrubs of the Cape.

OSTRACION, in ichthyology, a genus of the branchiostegous order of fishes, of a globose, oval, or ovato-quadrangular figure: the skin is always very firm and hard; and is in some species smooth, in others entirely covered with spines; and finally, in some the spines entirely occupy only particular places; there are no belly-fins, and the others are five in number, viz. two pectoral or lateral fins, one on the back, the pinna ani, and the tail. There are 12 species of this genus. the triqueter has a triangular body unarmed; inhabits India; the back appearing as if covered with rhombic marks cut transversely. The quadricornus, with frontal and subcaudal spines, inhabits India and Guinea.

OSTRACION, trunk-fish, a genus of fishes, of the order nantes; the generic character is, teeth pointing forwards, cylindric rather blunt; body mailed by a bony covering.

OSTREA, the *oyster,* in zoology, a genus belonging to the order of vermes testaceæ. The shell has two unequal valves; the cardo has no teeth, but a small hollowed one with transverse lateral streaks. There are thirty-one species, principally distinguished by peculiarities in their shells. The common oyster is reckoned an excellent food; and is eaten both raw and variously prepared. The character of the genus, in the words of Barbut, is, "The animal a tethys; the shell bivalve, unequivalve, with something like ears; the hinge void of teeth, with a deep oval hole, and transverse streaks on the sides. There is no womb nor anus." The genus is divided into four families, of which ostrea is the last.

The oyster differs from the muscle in being utterly unable to change its situation. It is entirely without a tongue, which answers the purposes of an arm in the other animal, but nevertheless is often attached very firmly to any object it happens to approach.

Oysters usually cast their spawn in May, which at first appears like drops of candle-grease, and sticks to any hard substance it falls upon. These are covered with a shell in two or three days; and in three years the animal is large enough to be brought to market. As they invariably remain in the places where they are laid, and as they grow without any other seeming food than the afflux of sea-water, it is the custom at Colchester, and other parts of England, where the tide settles in marshes on land, to pick up great quantities of small oysters along the shore, which, when first gathered, seldom exceed the size of sixpence. These are deposited in beds where the tide comes in, and in two or three years grow to a tolerable size. They are said to be better tasted for being thus sheltered from the agitations of the deep; and a mixture of fresh water entering into these repositories, is said to improve their flavour, and increase their growth and fatness. The oysters, however, which are prepared in this manner, are by no means so large as those found sticking to rocks at the bottom of the sea, usually called rock-oysters. These are sometimes found as broad as a plate, and are admired by some as excellent food. But what is the size of these compared to the oysters of the East Indies, some of whose shells have been seen two feet over! The oysters found along the coast of Coromandel, are capable of furnishing a plentiful meal for eight or ten men; but it seems universally agreed that they are no way comparable to ours for delicacy of flavour

OSTRICH See STRUTHIO.

OTIS, the *bustard*, in ornithology, a distinct genus of birds, of the order of the gallinæ, the characters of which are these: there are three toes on each foot, all turned forwards; and the head is naked, or has no comb. There are four species, principally distinguished by their colour. One of the species, the tarda, or bustard, (see plate Nat. Hist. fig. 309,) is the largest of the British land fowl, the male at a medium weighing 25 pounds; there are instances of some very old ones weighing 27; the breadth nine feet; the length near four. Besides the size and difference of colour, the male is distinguished from the female by a tuft of feathers about five inches long on each side of the lower mandible. Its neck and head are ash-coloured; the back is barred transversely with black and bright rust-colour; the greater quill-feathers are black; the belly white; the tail is marked with broad red and black bars, and consists of twenty feathers; the legs dusky. The female is about half the size of the male: the crown of the head is of a deep orange, traversed with black lines; the rest of the head is brown. The lower part of the fore side of the neck is ash-coloured; in other respects it resembles the male, only the colours of the back and wings are more dull. The birds inhabit most of the open countries of the south and east parts of this island, from Dorsetshire as far as the Wolds in Yorkshire. Bustards lay only two eggs of the size of those of a goose, of a pale olive brown, marked with spots of a dark colour; they make no nest, only scrape a hole in the ground. In autumn they are (in Wiltshire) generally found in large turnip-fields near the downs, and in flocks of 50 or more.

OTTER. See MUSTELA.

OVAL, an oblong curvilinear figure, otherwise called ellipsis. The proper oval, however, or egg-shape, differs considerably from that of the ellipsis, being an irregular figure, narrower at one end than at the other; whereas the ellipsis, or mathematical oval, is equally broad at each end; though it must be owned, these two are commonly confounded together, even geometricians calling the oval a false ellipsis.

OVERSEERS *of the poor*. By 43 Elizabeth, c. 2, § 1, the churchwardens of every parish, or two substantial householders, to be nominated yearly in Easter week, or within one month after Easter, under the hand and seal of two justices of the peace of the county, shall be overseers of the same parish. In general, all persons are liable to serve, with some exceptions as to peers of the realm, clergymen, parliament men, attornies, practising barristers, the president and members of the college of physicians, surgeons, and apothecaries free of the hall; dissenting ministers, prosecutors of felons, having a Tyburn ticket, and soldiers actually serving in the militia. Their duty consists in raising the poors'-rate, taking care of the poor, giving relief to casual poor, and removing persons who come to settle in a tenement under 10*l.* a year, &c. without a certificate. They are also to bind out the children of poor persons, and in that case the infant parish apprentice and his master cannot vacate the indentures without the overseers. They are also to procure orders of maintenance of bastards to be made, and bonds to be taken from the reputed father to indemnify the parish.

OVERT ACT. In the case of treason in compassing or imagining the death of the king, this imagining must be manifested by some open act; otherwise being only an act of the mind it cannot fall under any judicial cognizance. Bare words are held not to amount to an overt act, unless put into writing, in which case they are then held to be an overt act, as arguing a more deliberate intention. No evidence shall be admitted of any overt act, that is not expressly laid in the indictment. 7. W. c. 3.

OVIS, *sheep*, a genus of quadrupeds of the order pecora; the generic character is, horns hollow, wrinkled, turning backwards, and spirally intorted; front teeth, eight in the lower jaw; canine-teeth, none.

O. aries, or the common sheep. This animal, in its state of complete domestication, appears equally stupid as it is harmless, and seems nearly to justify the observations of Buffon, who describes it as one of the most timid, imbecile, and contemptible of quadrupeds. When sheep, however, have an extensive range of pasture, and are left in a considerable degree to depend upon themselves for food and protection, they exhibit more respectability of character. A ram has been seen in these circumstances to attack and beat off a large and formidable dog, and even a bull has been felled by a stroke received between his eyes, as he was lowering his head to receive his adversary on his horns and toss him into the air. When individual efforts are unequal to the danger, sheep will unite their exertions, placing the females and their young in the middle of an irregular square, the rams will station themselves so as to present an armed front on every side to the enemy, and will support their ranks in the crisis of attack, harassing the foe by the most formidable and sometimes fatal blows. Sheep display considerable sagacity in the selection of their food, and in the approach of storms they perceive the indications with accurate precision, and retire for shelter always to the spot which is best able to afford it. The domestic sheep is scarcely ever found (excepting in temperate latitudes) in a state approaching to perfection. In hot regions its wool degenerates into a species of hair, and in rigid climates, though the wool is fine at the roots, it is coarse towards the surface.

Of all the domestic animals, none is so subject to various disorders as the sheep. Of these, one of the most extraordinary, as well as the most fatal, is the rot, owing to vast numbers of worms, of the genus fasciola, which are found in the liver and gall-bladder. They are of a flat form, of an oval shape, with slightly pointed extremities, and bear a general resemblance to the seeds of a gourd.

OUNCE, a little weight, the sixteenth part of a pound avoirdupois, and the twelfth part of a pound troy; the ounce avoirdupois is divided into sixteen drams, and the ounce troy into twenty pennyweights.

OUNCE. See FELIS.

OUTLAWRY, is being put out of the law, or out of the king's protection. It is a punishment inflicted for a contempt in refusing to be amenable to the process of the higher courts. By outlawry in civil actions, a person is put out of the protection of the law, so that he is

not only incapable of suing for the redress of injuries, but may be imprisoned, and forfeits all his goods and chattels, and the profits of his land; his personal chattels immediately upon the outlawry, and his chattels real, and the profits of his lands, when found by inquisition.

OUTWORKS, in fortification, all those works made withoutside the ditch of a fortified place, to cover and defend it. See Fortification.

OX. See Bos.

OXALATES, are compounds of the salifiable bases with oxalic acid.

OXALIC ACID. This acid, which abounds in wood sorrel, and which, combined with a small portion of potash, as it exists in that plant, has been sold under the name of *salt of lemons*, to be used as a substitute for the juice of that fruit, particularly for discharging ink-spots and iron-moulds, was long supposed to be analogous to that of tartar.

In the year 1776, however, Bergmann discovered, that a powerful acid might be extracted from sugar by means of the nitric; and a few years afterwards Scheele found this to be identical with the acid existing naturally in sorrel. Hence the acid began to be distinguished by the name of *saccharine*, but has since been known in the new nomenclature by that of oxalic.

The oxalic acid is a good test for detecting lime, which it separates from all the other acids, unless they are present in excess. It has likewise a greater affinity for lime than for any other of the bases, and forms with it a pulverulent insoluble salt, not decomposable except by fire, and turning syrup of violets green. Oxalic acid acts as a violent poison when swallowed in the quantity of 2 or 3 drachms; and several fatal accidents have lately occurred in London, in consequence of its being improperly sold instead of Epsom salts. Its vulgar name of salts, under which the acid is bought for the purpose of whitening boot-tops, occasions these lamentable mistakes. But the powerfully acid taste of the latter substance, joined to its prismatic or needle-formed crystallization, are sufficient to distinguish it from every thing else. The immediate rejection from the stomach of this acid by an emetic, aided by copious draughts of warm water containing bicarbonate of potash, or soda, chalk, or carbonate of magnesia, are the proper remedies.

OXIDATION. The process of converting metals or other substances into oxides, by combining with them a certain portion of oxygen. It differs from *acidification* in the addition of oxygen not being sufficient to form an acid with the substance oxided.

OXIDES. Substances combined with oxygen, without being in the state of an acid.

OXYGEN GAS. This gas was obtained by Dr. Priestley in 1774 from red oxide of mercury exposed to a burning lens, who observed its distinguishing properties of rendering combustion more vivid and eminently supporting life. Scheele obtained it in different modes in 1775; and in the same year Lavoisier, who had begun, as he says, to suspect the absorption of atmospheric air, or of a portion of it, in the calcination of metals, expelled it from the red oxide of mercury heated in a retort. Oxygen gas forms about a fifth of our atmosphere, and its base is very abundant in nature. Water contains 88,88 per cent. of it; and it exists in most vegetable and animal products, acids, salts, and oxides. See Chemistry.

OXYMEL, is a compound of honey and vinegar.

OXYMURIATIC ACID, or Chlorine. See Chemistry.

OYER *of a deed*, in law, is when a man brings an action upon a deed, bond, &c. and the defendant appears and prays that he may hear the bond, &c. wherewith he is charged; and the same shall be allowed him. And he is not bound to plead till he has it, paying for the copy of the instrument. It is then set forth upon the pleadings.

Oyer and **Terminer**, in law, is a court by virtue of the king's commission, to hear and determine all treasons, felonies, and misdemeanors. This commission is usually directed to two of the judges of the circuit, and several gentlemen of the county; but the judges only are of the quorum, so that the rest cannot act without them.

Oyer *of the records*, in law, is a petition made in court, that the judges for more satisfactory proof, will be pleased to hear or look upon any record.

O YES, corrupted from the French *oyez*, hear ye, is an expression used by the crier of a court, in order to enjoin silence, when any proclamation is made.

OYSTER. See Ostrea.

P.

P, or p, the fifteenth letter, and eleventh consonant of the alphabet. In music, P. stands for piano, or softly; P P. for piu piano, *i. e.* more softly; and P P P. for pianissimo, or very softly.

Among astronomers, P. M. is used to denote post meridian, or afternoon; and sometimes for post mane, *i. e.* after midnight.

As a numeral, P. signifies the same as G, *viz*, 400; and with a dash over it, thus P̄. 400,000.

Among physicians, P. denotes pugil, or the eighth part of an handful; P. Æ. partes æquales, or equal parts of the ingredients; P. P. signifies pulvis patrum, *i. e.* the Jesuit's powder; and ppt. præparatus, prepared.

PACE, a measure taken from the space between the two feet of a man, in walking, usually reckoned two feet and an half, and in some men a yard or three feet. See Measure.

The geometrical pace is five feet; and 60,000 such paces make one degree of the equator.

PACK, in commerce, denotes a quantity of goods made up in loads or bales for carriage. A pack of wool is 17 stone and two pounds, or a horse's load.

PACKERS, persons whose employment it is to pack up all goods intended for exportation; which they do for the great trading

companies and merchants of London, and are answerable if the goods receive any damage through bad package.

PACOS. See CAMELUS.

PÆONIA, *peony*, a genus of the digynia order, in the polyandria class of plants, and in the natural method ranking under the 26th order, multisiliquæ. The calyx is pentaphyllous; the petals five; there are no styles; the capsules are polyspermous. There are five species, most of them hardy; they are large herbaceous flowery perennials, with tuberous roots, sending up strong annual stalks from one to three feet in height, terminated by very large flowers of a beautiful red colour, and much larger than any rose. The common officinal, or male peony, is also remarkable for its capsules turning backward, opening and displaying their red inside, together with the numerous seeds in a singularly agreeable order, appearing very ornamental after the flower is past.

PAGANISM, the religion of the Heathen nations, in which the Deity is represented under various forms, and by all kinds of images, or idols; it is therefore called idolatry, or image worship. The theology of the Pagans was of three sorts, *viz.* fabulous, natural, and political or civil. The first treats of the genealogy, worship, and attributes of their deities; who were, for the most part, the offspring of the imagination of poets, painters, and statuaries. To their gods were given different names and opposite attributes, ascribing to them every species of vice, as well as to [illegible] very vir

PAGE, a youth of state retained in the family of a prince or great personage, as an honourable servant, to attend in visits of ceremony, carry messages, bear up trains, robes, &c. and at the same time to have a genteel education, and learn his exercises.

PAGOD, or PAGODA, a name whereby the East Indians call the temple, in which they worship their gods. The pagod usually consists of three parts: the first is a vaulted roof, supported on stone or marble columns; it is adorned with images; and, being open, all persons without distinction are allowed to enter it. The second part is filled with grotesque and monstrous figures, and no person is allowed to enter it but the brahmins themselves. The third is a kind of chancel, in which the statue of the deity is placed. It is shut up with a very strong gate.

PAGOD, or *Pagoda*, is also the name of a gold or silver coin, current in several parts of the East Indies, value 5*s*.

PAINTING, is the art of representing all objects of nature visibly, by lines and colours on a plain surface. It has also the power of expressing by the same means conceptions and images of the mind which do not actually exist in any of the usual forms of nature. It is to be considered as an art displaying either conjointly or separately the powers of imagination and imitation: and may be divided into invention, which regards the original thought or conception of the subject; and into composition, design, and colouring, which regard the execution of the work.

Invention consists generally in the choice of such subjects as are best calculated to answer some great and interesting end; and particularly in discovering or selecting such subjects as are capable of being most appropriately expressed by painting, and of producing a powerful effect by such means as are distinctively placed within the compass of that art.

Composition regards the arrangement of the subject both as to forms, and to the general effects of light and shade, and of colour. It comprehends the general distribution and grouping of the figures, their combination or contrast, the choice of attitudes, the disposal of draperies, the situation of the scene itself, as well as the distribution and connection of all the various parts of scenery and ornament.

Design.—Although this part of the art is, in a certain degree, requisite even in making the first rough sketch, it is not until afterwards that the artist exerts his utmost powers to give that exact proportion, that beauty of contour, and that grace and dignity of action and deportment to his figures, which constitute the perfection of *design*. The most perfect knowledge of form, however, is not the only branch of painting, termed design. The art of *foreshortening*, by which a limb or a figure, although only occupying a diminished space on the canvas, is rendered in appearance of its full length and magnitude, is an equally indispensable object of the artist's attainment.

Colouring regards, first, the infinite variety of hues with which nature distinguishes her forms, agreeably to the degree and mixture of the rays of light which their surfaces reflect; and, secondly, the distribution, apposition, and accompaniment, of various hues or tints, so as to produce the effect most pleasing to the sight, a circumstance in which nature always delights.

Colouring.—It is the duty of the colourist to consider, that as there are two sorts of objects, the natural or real, and the artificial or painted, so there are also two sorts of colours, viz. the natural, or that which makes all the objects in nature visible to us, and the artificial, or that, which, by a judicious mixture of simple colours, imitates those natural ones in all their various situations and circumstances.

Of the few maxims which can be offered on the subject of colouring, the following are the least questionable:

We must learn to view nature to advantage, in order to represent her well. There are two manners of colouring; the one depending on habit, the other on the true knowledge of colours. The first is confined, the second unlimited.

The harmony of nature in her colours arises from objects participating of one another by reflection; for there is no light which does not strike some body; nor is there any enlightened body which does not reflect its light and colour at the same time, in proportion to the force of the light, and according to the nature of the colour. This participation of reflection in light and colour, constitutes that union of colouring which it is the business of the painter to imitate.

Variety of tints, very nearly of the same tone, employed in the same figure, and often upon the same part, with moderation, contribute much to harmony.

Any loading or overcharging of colouring, for whatever purpose it is used, must be so discreetly managed, as not to destroy the character of the object.

The repetition of the same colour in a picture is to be avoided, unless where it serves to connect the various masses of a composition. The eye becomes tired with viewing the same object; it loves variety artfully presented to it.

The apparent value of colours in a picture (as in all things) arises from comparison.

Several colours which, placed unmixed by one another, have a kind of aerial brightness, when mixed together, produce a disagreeable earthy colour: for instance, ultramarine with fine yellow, or fine vermilion.

Colours which by mixture lose strength and become harmonious, are called broken colours, and contribute as greatly to the sweetness and softness of tones in pictures as they subtract from their brightness.

Chiaro Scuro.

The art of chiaro-scuro consists, 1st. In connecting and combining the figures or objects of a composition in such masses of light and of shade, as are both the most pleasing to the eye and the best calculated for the just developement and display of the subject. 2dly. In assigning to each object the colour most corresponding (on account of the force or qualities above mentioned) to its respective place in the general mass or group, and at the same time best harmonizing with the other colours of the picture, either by its natural and proper tone, or by the reflected hues which it receives from adjoining or surrounding objects. The beauty of these reflexes depends on the skilful adaptation of transparent or opaque colours. 3rdly. In the judicious introduction of such accidents as contribute to strengthen the general effect and character of the work. It is on chiaro-scuro, says Mengs, that depends the expression of the character of a picture, whether it is gay or gloomy, cheerful or solemn The distribution of objects forms the masses of chiaro-scuro, by combining or connecting their lights and shades in such a manner as to prevent the eye from wandering confusedly over the work.

Composition.

Composition may be divided into the general distribution of objects, the grouping, the choice of attitudes, the contrast, the cast of draperies, and the management of the back ground, or the connection of the whole effect.

In composition, as far as regards the general distribution of objects, the painter ought to contrive that the spectator may, at the first sight, be struck with the general character of the subject, or at least may comprehend its principal scope. This effect is most readily produced by placing the most essential figures in the most conspicuous places, provided it can be done without violence or impropriety. Besides this distinctness in the general expression of the subject, the beauty of the composition will depend on the variety, connection, and contrast, displayed in the distribution of objects; provided, in like manner, that these are conformable to the nature of the subject, whether gay, familiar, full of motion and hurry, or still, solemn, and melancholy.

The grouping regards both design and chiaro-scuro. In the former, it respects the figures principally concerned in the expression of the subject, which must necessarily be near to, or distant from one another, as their actions, conversations, or other mutual relations, require. In the latter, it regards those masses which are formed from objects which may be properly arranged together, and those effects of light and shade which are formed in consequence of such assemblage or union. These are the points to which the attention must be principally and diligently directed in forming the groups of a composition. The choice of attitudes is the principal subordinate division of grouping. Whatever attitude is given, it must not only contribute its due portion to the completion of the group, but the greatest care must be taken by the painter, that it does not appear to be introduced for that purpose merely. It must be appropriate to the character of the individual figure, and expressive of its requisite action: and it must at the same time, combine whatever beauty of form can be shewn by such a selection of turns or views of the body, as the necessary circumstances will admit. The knowledge of generic characters, under the various modifications of sex, age, and condition; of the various operations of the passions in the human mind; and a thorough acquaintance with the circumstances of the history or other subjects to be represented; are the best guides to a good choice of attitudes The management of the back-ground, or connection of the general effect, is effected by a due combination of lights and shades, by an union of colours, and by such oppositions or contrasts as are sufficient to relieve the distinct groups, and to give repose to the eye.

The different classes of painting.

Painting is chiefly divided into historical (comprehending allegorical and mystical,) grotesque, portrait, fancy, animals, fruits and flowers, battles, landscape, sea-views, architecture, still life. The subordinate divisions of all these are endless. The first has been sufficiently spoken of under the head of *invention,* in the present article.

Grotesque paintings are to be found in the celebrated Loggia of the Vatican palace at Rome, painted from the designs of Raffaelle and in the ceiling of the portico of the Capitol, carved from those of Michael Angelo. Of portrait, as being a branch of painting much cultivated in our country, it is requisite to give a more detailed account.

Portraiture. The greatest perfection of a portrait is extreme likeness, and the greatest fault is the resemblance of a person for whom it was not designed, unless we are inclined to except a still more grievous defect, *viz.* the want of resemblance to any person whatever.

Various difficulties attend, and not seldom impede, the execution of this task. It is true that there is not a single person in the world of whatever age, sex, or condition, who has not a peculiar character both in body and face; but it is also the essential duty of portraiture, that it not only imitates what we see in nature, but that it exhibit such views of nature as are confessedly the most advantageous to the person represented. The moment that the idea raised by the sight of the portrait is inferior to that raised by the sight of the person, the labour of the artist sinks into the debasing region of caricature. The resemblance, as well as every other excellence, of a portrait, depends on feature, expression, air, colouring, attitude

and attire. The features require to be carefully examined and studied by inspection in many different views, so that at the moment when the painter puts his pencil to the canvas, he may be possessed not only of the apparent form of each particular feature, in the view in which he represents it, but of its real and characteristic form also, the full expression of which is not discernible in every view. Each particular feature should appear so distinctly shaped, as that an exact model of the real head could be formed from the picture, if requisite; and they must be at the same time so blended in the general mass of the face, that no one shall obtrude itself on the eye beyond the rest. The peculiar mode of touch, or execution, whereby each feature is best discriminated, can only be learned from practice, and the attentive study of the best masters.

With regard to the methods of proceeding in the execution of a portrait, they have been, and are, so exceedingly various, in various masters, that a discussion of them would lead to an endless labyrinth.

Nothing varies more quickly, more discernibly, or more frequently, than the colour of a sitter's face. Great care must therefore be taken to establish an uniform judgment of the sitter in this respect also; for the colouring of the skin, or complexion being an effusion of nature, tending to discover the true tempers of persons, exactness of imitation here becomes essential to the exhibition of character. It may be therefore expedient to watch the first moments of the appearance of colour in the sitter, who, sooner or later, from a continuance in one posture, loses those spirits, which, at his first sitting down, gave to every part of the face a livelier and fresher hue. There is no other point of painting in which the paradox may be more truly asserted, "that the painter, who only paints what he sees, will never arrive at perfect imitation."

The other classes of painting are sufficiently denoted by their names, excepting the last, viz. *still life*, of which it may by requisite to add that the term is applied to all inanimate objects, but chiefly to all household furniture, ornaments, and instruments of use, &c.

Modes and Materials of Painting.

The different modes of painting now in use are:

Oil painting; preferable to all other methods, as it admits of a perfect gradation of tints in the most durable of all materials, except those of Mosaic painting; in which an imitation of objects is produced by the junction of a great number of small pieces of natural marble of different colours fixed in stucco, a mortar, so that if the mortar is well prepared, the monuments of this art may descend to the most remote ages.

Fresco painting; which is performed with colours diluted in water, and laid on a wall newly plastered with which they incorporate, and are sometimes as durable as the stucco itself.

Crayon painting; in which colours, either simple or compound, are ground in water mixed with gum, and made into small rolls of a hard paste, which are then used on paper or parchment.

Miniature painting; which consists of colours prepared with water or gum, and laid on vellum or ivory.

Enamel painting; which is performed on copper or gold, with mineral colours, dried by fire. This method is also very durable.

Wax, or encaustic painting; performed by the mixture of wax with the varnish and colours.

Painting on glass, is too well known to need description, and performed by various methods.

Painting in distemper; which is with colours mixed with size, whites of eggs or any thin glutinous substance, and used on paper, linen, silk, board, or wall.

Painting in water-colours, more properly called limning; it is performed with colours mixed with water, gum, size, paste, &c. on paper, silk, and various other materials.

To these is to be added elydoric painting, consisting of a mixed use of oil colours and water.

Painting in Fresco.

Before you begin to paint, it is necessary to apply two layers of stucco on the place where your work is to be executed. If you are to paint on a wall of brick, the first layer is easily applied; if of free-stone closely joined, it is necessary to make excavations in the stone, and to drive in nails or pegs of wood, in order to hold the layer together.

The first layer is made of good lime and a cement of pounded brick, or which is better, river-sand, which latter forms a layer more uneven, and better fitted to attach the second smooth layer to its surface. The ancients appear to have possessed the art of making this species of mortar superior to any now in use.

Before applying the second layer, on which you are to paint, it is requisite that the first be perfectly dry, as the lime while moist emits a pernicious effluvium.

When the first layer is perfectly dry, wet it again with water, in proportion to its dryness, that the second layer may more easily incorporate with it.

The second layer is composed of lime, slaked in the air, and exposed for a whole year, and of river-sand of an equal grain, and moderately fine. The surface of this second layer must be uniformly even. It is laid on with a trowel; and the workman is provided with a small piece of wood, to remove the large grains of sand, which if they remained, might render the surface uneven.

To give a fine polish to this surface, a sheet of paper should be applied on it, and the trowel passed and repassed over the paper; this caution will prevent any little inequalities which might injure the effect of the painting at a distance.

The workman must not extend the layer over a greater space than the painter is able to finish in a day, as it is necessary that the ground should always be fresh and moist under his pencil; and it is on this account that the readiness of the artist's hand becomes so requisite a quality in the execution of works in fresco.

The ground being thus prepared, the painter begins his work; but as painting in fresco must be executed rapidly, and as there is no time to retouch any of the strokes of the brush with good effect, he will first have taken care to provide himself with large finished drawings in chalk or paintings in distemper, of the same size as the work which he has to paint, so that he shall

have only to copy these drawings on the wall. The painter traces the outlines of the figures on the plaister, by passing a steel point over them, or pricking them closely and passing very finely powdered charcoal through the pricked holes. All natural earths are good for painting in fresco. The colours are ground and tempered with water. It is to be remarked, that all the colours used in this method of painting brighten as they grow dry, excepting the pavonazzo or red varnish, the brownish red ochre, ruth ochre, and the blacks, particularly those that are passed through the fire. The best colours are white, made of old lime, and white marble-dust (the proportional quantity of the latter depends on the quality of the lime, and must be found by trial, as too great a quantity of marble-dust will turn the colour black; ultramarine blue, the black of charcoal, yellow ochre, burnt vitriol, red earth, green of Verona, Venetian black, and burnt ochre. Other colours which require to be used with greater precaution, are amel, or enamel blue, and cinnabar. Enamel blue must be applied instantaneously, and while the lime is very moist, otherwise it will not incorporate; and if you retouch with it, you must do it in an hour or more after the first application of it, in order to increase its lustre. Cinnabar has a splendour almost beyond all other colours, but it loses it when mixed with lime. It may, however, be employed in places not exposed to the air, if proper care is used in preparing it. For this purpose, reduce a quantity of the purest cinnabar to powder, put it into an earthen vessel, and pour lime water on it two or three times. By this process the cinnabar receives some impression from the lime water, and you may then use it with greater safety. The white of lime is formed by mixing lime, slaked a long time before with good water. The lime deposits a sediment at the bottom of the vessel; when the water is poured off, this sediment is the white of lime. Another kind of white may likewise be made from egg shells, pounded, in great quantities, and boiled in water, together with quick lime, and afterwards put into a strainer and washed repeatedly with spring water. The shells must be again pounded until the water employed for that purpose becomes pure and limpid; and when the shells are completely reduced to powder, they are ground in water made up in small pieces and dried in the sun. The effect of this colour must be ascertained by experiment. Ochres of all kinds make good colours for fresco, being previously burnt in iron boxes. Ultramarine never changes, and seems to communicate its permanent quality to the colours with which it is mixed.

Distemper.

In addition to what has been said of this method of painting under its proper article, the following particulars are worthy of notice:

Until the discovery of oil-painting, the methods most generally adopted by all Italian painters were those of distemper and fresco.

In distemper, when they painted on boards, they often pasted over the boards a piece of fine cloth, to prevent them from parting; they then laid on a layer of white, after which, having tempered their colours with water and paste (or rather with water and yolks of eggs beat together with little fig tree branches, the milk of which mixed with the eggs) they painted their pictures with this mixture. All colours are proper for distemper, except the white of lime, which is used in fresco only. Azure and ultramarine must be used with a paste made of gloveskin, or parchment, as they will turn green when mixed with yolks of eggs. If the work is on walls, care must be taken that they are quite dry. The painter must even lay on two layers of hot paste before he applies the colours, which, if he pleases, he may also temper with paste; the composition of eggs and fig-tree branches being only retouching, and the paste rendering the work more durable. When used, it must be kept hot by fire. This paste, as has been said, is made of glove-skin or parchment.

When a painter in distemper would work on cloth, he must choose that which is very old and smooth.

Oil painting.

The principal advantage of oil-painting over other methods consists in the colours drying less speedily, so that it allows the painter to finish, smooth, and retouch his works, with greater care and precision. The colours also being more blended together, produce more agreeable gradations, and a more delicate effect.

As the superior beauty of oil painting depends on the vividness and delicacy of durable tints, we shall present the student with the best rules drawn from a careful study of the works of Vandyck and Rembrandt, two of the most remarkable colourists in different styles.

Of painting flesh.

Flake-white is the best white known to us. This colour should be ground with the finest poppy-oil that can be procured.

White comes forward to the eye with yellows and reds, but retires with blues and greens. It is the nature of all whites to sink into whatever ground they are laid on, therefore they should be laid on white grounds.

Ivory-black is the best black: it is a colour which mixes kindly with all the others. It is the true shade for blue; and when mixed with a little Indian red, it is the best general shadow-colour that can be used. It is generally ground with linseed oil, and used with drying oil.

Black is a cold, retiring colour.

Ultramarine is the finest blue in the world: it is a tender retiring colour, and never glares, and is a beautiful glazing colour. It is used with poppy-oil.

Lake is a tender deep red, but of no strong body; therefore, it should be strengthened with Indian red. It is the best glazing colour that can be used. It is ground with linseed-oil, and used with drying oil.

Burnt umber is a fine warm brown, and a good working strong colour: it is of great use in the hair, and mixes finely with the warm shade.

Process. The process of oil-painting, particularly in the colouring of flesh and in landscape, is to be divided into three stages, or paintings.

The colours and tints necessary for the first and second stages of painting flesh, are: 1. Flake, or fine white; 2. Light ochre and its

tints; 3. light red and its two tints; 4. vermilion and its tint; 5. a tint composed of lake, vermilion, and white; 6. rose tint; 7. blue tint; 8. lead tint; 9. green tint; 10. half-shade tint, made of Indian red and white; 11. shade tint; 12. red shades; 13. warm shade.

The finishing palate for a complexion requires five more, viz. 1. carmine and its tint; 2. lake; 3. brown pink; 4. ivory-black; 5. Prussian blue.

First stage, or dead-colouring of flesh.

The first lay of colours consists of two parts; the one is the work of the shadows only, and the other that of the lights.

The work of the shadows is, to make out all the drawing very correctly with the shade tint, in the same manner as if it was to be done with this colour only, and remember to drive or lay the colour sparingly. The lights should be all laid in with the light red tint, in different degrees, as we see them in nature.

These two colours united, produce a clean, tender, middle tint. In uniting the lights and shades, you should use a long softener, about the size of a large swan-quill, which will help to bring the work into character, and leave the colouring more delicate, then go over the darkest shadows with the red or warm shade, which will finish the first lay.

The warm shade being laid on the shade tint, improves it to a warmer hue; but if laid instead of the shade tints, it will spoil the colours it mixes with; and if the red shade is laid first, instead of the shade tint, the shadows would then appear too red: therefore, notwithstanding these two colours are the best that can be for the shadows, yet they are too strong to be laid alone, which is a proof of the great use and merit of the shade tint. Here we may observe that the shade and light-red tints are so friendly in their nature, that even in continually altering and changing, they always produce a clean colour of a pearly hue.

Next. In order to finish the first painting, improve the reds and yellows to the complexion, and after them the blues; observing, that the blues on the reds make the purple, and on the yellows produce the green. The same method is to be understood of the shadows: but be sure to leave them clean, and not too dark; therefore, allowance should be made in the grounds with the light red, because glazing them will make them darker. When the cloth is of a dark, or bad colour, there must be a strong body of colour laid all over the shadows, such as will not sink into the ground, but appear warm, and a little lighter than the life, so that it may be of the same forwardness to finish as if it had been a light ground; therefore, the business of dead-colouring is, that you leave it always in the same order for finishing, though the colour of the cloth is quite the reverse.

Second painting, or second stage.

The second painting begins with laying on the least quantity that can be of poppy-oil; then wipe it almost all off with a dry piece of a silk handkerchief.

The second painting is also divided into two parts: one, the first lay of the second painting; which is scumbling the lights, and glazing the shadows: the other, finishing the complexion with the virgin tints, and improving, as far as you can, without daubing.

First. Scumbling is going over the lights, where they are to be changed, with the light red tints, or some other of their own colours, such as will always clear and improve the complexion, with short stiff pencils; but such parts only as require it, otherwise the beauty of the first painting will be spoiled.

The light red tint improved is the best colour for scumbling, and improving the complexion in general. Where the shadows and drawing are to be corrected, you should do it with the shade tint, by driving the colour very stiff and bare, that you may the easier retouch and change it with the finishing tints. Some parts of the shadows should be glazed with some of the transparent shadow-colours, such as will improve and come very near to the life; but be sure not to lay on too much of it, for fear of losing the hue of the first painting, the ground of which should always appear through the glazing. Be very careful in uniting the lights and shades, that they do not mix dead and mealy; for the more the lights mix with the shades, the more mealy those shades will appear. Thus far the complexion is prepared and improved, in order to receive the virgin tints.

Second. Go over the complexion with the virgin tints. These are the colours which improve the colouring to the greatest perfection, both in the lights and shadows.

This should be done in the same manner as you laid them in the second part of the first painting; that is, with the reds, yellows, and blues, blending them with delicate light touches of the tender middle tints without softening. Leave the tints and their grounds clean and distinct, and be content to leave off whilst the work is safe and unsullied, leaving what is farther required for the next sitting; for, in attempting the finishing touches before the other is dry, you will lose the spirit and drawing, and your colours will become of a dirty hue.

Third painting, or finishing.

It is to be supposed, the complexion now wants very little more than a few light touches; therefore there will be no occasion for oiling.

Begin with correcting all the glazing; first, where the glazing serves as a ground or under part; then determine what should be done next, before you do it, so that you may be able to make the alteration on the part with one stroke of the pencil. By this method you preserve both the glazing and the tints; but, if it happens that you cannot lay such a variety of tints and finishing colours as you intended, it is much better to leave off while the work is safe and in good order; because those few touches, which would endanger the beauty of the colouring, may easily be done, if you have patience to stay till the colours are dry; and then, without oiling, add those finishings with free light strokes of the pencil.

Of painting draperies.

In order to shew the nature and different degrees of colours or tints used in painting draperies, we must first determine how many divisions are absolutely necessary to make the first lay of colours, and after that the reflections and finishing tints.

The right method of painting draperies in

general is to make out the whole, or the first lay, with three colours only, viz. the lights, middle tint, and shade tint.

The reflections of draperies and satins are generally productions of their own, and are always lighter than the shadows on which they are found; and being produced by light, will consequently have a light warm colour, mixed with the local colour that receives them. Here it will be necessary to notice the general method of managing the colours of the first lay, and those of the reflections and finishing tints.

In the first lay, the high lights should be laid with plenty of stiff colours, and then shaped and softened into character with the middle tint very correctly. Where the gradations of the lights are slow, as in the large parts, it will be proper to lay the middle tint first at their extremities with a tool that will drive the colour, and leave it sparingly; because the lights will mix and lie the better upon it. Next make out all the parts of the shadows with the tint driven bare. After this comes the middle tint, for the several lights and gradations; which should be very nicely wrought up, to character, without touching any of the high lights which finish the first lay.

The reflects and finishing tints are in general the antipathies of the first lays; they will, without great care, dirty the colours on which they are laid; and therefore should be laid with a delicate light touch, without softening. If it is overdone, endeavour to recover it with the colour of the part on which it was laid, this may be done directly, or when it is dry. Whether the reflects proceed from the same colour, or any other, the method of using them is the same.

Before we proceed to the particular colours, it will be proper to make some observations on their grounds.

It often happens, that the colour of the cloth is very improper for the ground of the drapery; and when it is so, you should change it with those colours which are most proper to improve and support the finishing colours. This method of dead-colouring must consequently preserve them in the greatest lustre. In dead-colouring, you should lay the lights and shades in a manner so as only to shew a faint idea of them, with regard to the shape and roundings of the figure. If you have a design to work from, then it will be proper to make all the large and principal parts in their places, which should always be done with a colour that is clean and lighter than the intended drapery, though in general of the same hue; and let the shadows be no darker than a middle tint. These should be mixed and broken in a tender manner, and then softened with a large tool, so that nothing rough and uneven is left to interrupt or hurt the character of the finishing colours.

White satin. All whites should be painted on white grounds, laid with a good body of colour, because this colour sinks more into the ground than any other.

There are four degrees of colours in the first lay, to white satin. The first is the fine white for the lights; the second is the first tint, which is made of a fine white and a little ivory-black, mixed to an exact middle degree between the white and the middle tint. This colour follows the white; and it is with this you should shape the lights into character before you lay on any other: and take care that this first tint appears distinctly between the white and the middle tint, otherwise the beauty and the character of the satin will be spoiled.

The middle tint should be made of white, black, and a little Indian red. These three colours are very friendly, and mix to a beautiful clear colour of a pearly hue, which has the true brightness and warmth of the general hue of the satin. Remember to allow for the red hue changing a little to the lead. If there is occasion to make any part in the middle tint lighter, do it with the first tint only.

A little blue is sometimes used in the first tint of white satin.

Changeable colours. Changeable colours are made with four principal tints, viz. the high lights, middle tint, shade tint, and reflecting tint.

The greatest art lies in finding the exact colour of the middle tint, because it has more of the general hue of the silk than any o[illegible]e others. The shade tint is of the same hue with the middle tint, though it is dark enough for the shadows. The high lights, though often very different from the middle tint, should be of friendly-working colour, that will, in mixing with it, produce a tint of a clean hue.

The method of painting silks is to make out the folds with the shade tint, and then fill them up in the lights with the middle tint. This first lay should be done to your satisfaction before you add any other colours; and the stiffer the middle tint is used, the better the high lights may be laid upon it. The reflecting tint falls generally upon the gradating half shades, and should be laid with tender touches sparingly, for fear of spoiling the first lay.

This method of painting answers for all coloured silks, as well as changeable, with this difference only; that the plain colours require not so much art in matching the tints, as the changeable do. The last part of the work is the finishing and strengthening the shadows with an obscure tint, a little inclining to a mellowish hue; such as will not catch the eye, and interrupt the beauty of the lights.

Black. The best ground for black is light red for the lights, and Indian red and a little black for the shadows.

The finishing colours are, for the lights, black, white, and a little lake. The middle tint has less white, and more lake and black: the shade tint is made of an equal quantity of lake and brown pink, with a very little black.

The method of painting black is very different from that of other colours; for as in these the principal thing is to leave their lights clear and brilliant, so in black it is to keep the shadows clear and transparent. Therefore, begin with the shade tint, and glaze over all the shadows with it. Next, lay in the darkest shadows with black, and a little of the shade tint, very correctly. After that, fill up the whole breadth of lights with the middle tint only. All which should be done exactly to the character of the satin, velvet, cloth, &c. &c. and then finish with the high lights.

Here observe, the ground, being red, will bear out and support the reds, w[illegible]h are used in the finishing colours. The lake in the lights takes off the cold hue, and gives it a more beautiful colour. If the shade tint was of any other colour than a transparent warm hue, the sha

dows would consequently be black and heavy: because no other colours can preserve the warm brilliancy which is wanting in the shadows of the black, like lake and brown pink. Black is of a cold heavy nature, and always too strong for any other colour; therefore you should make an allowance in using it. There will be a few reflects in satin, which should be added as those of other colours; but they should be made of strong colours, such as burnt umber, or brown ochre, mixed with a little shade tint.

Though the grounds mentioned for the draperies are absolutely necessary for the principal and nearest figures in a picture, such as a single portrait, or the like; yet for figures which are placed behind the principal or front figures, their grounds should always be fainter in proportion to their local finishing colours.

Linen. The colours used in linen are the same as those in white satin, except the first tint, which is made of white and ultramarine ashes, instead of the black, and mixed to a very light bluish tint.

In the dead-colouring, take particular care that the grounds are laid very white and broad in the lights.

Of painting back-grounds.

The principal colours that are necessary for painting of back-grounds, as walls, buildings, or the like, are white, black, Indian red, light and brown ochre, Prussian, and burnt umber; from which the eight principal tints are made, as follows:

1. Pearl is made of black, white, and a little Indian red.
2. Lead, of black and white, mixed to a dark lead-colour.
3. Yellow, of a brown ochre and white.
4. Olive, of light ochre, Prussian, and white.
5. Flesh, of Indian red and white, mixed to a middle tint.
6. Murrey, of Indian red, white, and a little black, mixed to a kind of purple, of a middle tint.
7. Stone, of white, umber, black, and Indian red.
8. Dark shade, of black and Indian red only.

Here the lead tint serves for the blues, the flesh tint mixes agreeably with the lead, and the murrey is a very good blending colour, and of great use where the olive is too strong; the umber, white, and dark shade, will produce a fine variety of stone colours; the dark shade and umber, used plentifully with drying oil, make an excellent warm shadow-colour. All the colours should be laid with drying oil only, because they mix and set the better with the softener.

Where the marks of the trowel are so strong in the priming of the cloth, that one body of colours will not be sufficient to conceal it, lay a colour to prevent it, which should be dry before you begin with those parts you expect to finish at once painting.

Process. The process of painting back-ground is divided into two parts in stages; the first is the work of the first lay, the second that of the finishing tints.

Begin the first lay from the shadowed side of the head, and paint the lights first; from them go into the gradations and shadows, which should be done with a stiffish tool, very sparingly, with the dark shade and white, a little changed with the colours that will give it more of the required hue, but very near in regard to tone and strength, leaving them like mezzotinto.

The dark and warm shadows should be laid before the colours that join them. This do with the dark shade and umber, driven with drying oil. If those colours were laid on first, they would spoil the transparency, which is their greatest beauty The more the first lay is driven, the easier and better you may change it with the finishing tints, therefore you may lay them with the greater body.

The second part is to follow directly, whilst the first lay is wet, with those tints that are the most proper to harmonize and finish with.

Begin with the lights first, and remember, as you heighten and finish them, to do it with warmer colours; and let those be accompanied with fine tender cold tints. The lightest parts of the ground should be painted with a variety of light warm clear colours, which vanish and lose their strength imperceptibly in their gradations. Take care that you do not cover too much of the first lay, but consider it as the principal colour.

From the lights, go to the gradations and shadows; for when the lights are well adapted to produce and support the figure, it is easy to fall from them into whatever kind of shadows you find most proper; then soften and blend the whole with a long large hog-tool; which, with the strength and body of the drying oil, will melt and sweeten altogether, in such a manner as will seem surprisingly finished. Remember the tints will sink, and lose a little of their strength and beauty in drying. All grounds, as walls, &c. should be finished at once painting; but if they want to be changed, glaze them with a little of the dark shade and drying oil, driven very bare; on which, with a few light touches of the colour that is wanting, you may improve their hue. The dark shadows may also be strengthened and improved by glazing, which should be done after the figures are nearly finished, for fear of making them too strong.

Curtains should be dead-coloured when we paint the ground; and should be done with clean colours, of a near hue to the intended curtain, such as will support the finishing colours; do it with a tender sort of keeping, and near in regard to their tone in the lights, but much softer in the shadows: all which should be mixed and broken with the colours of the ground.

It will often happen, that we cannot make the folds the first painting; we should then leave the masses of light and shadow, in regard to the keeping of the picture, broad and well united together, such as may seem easy to finish on. The colours of the landscape, in back-grounds, should be broken and softened also with those of the parts which join them. This method will make all the parts of the ground, as it were, of one piece.

The sky should be broke with the lead and the flesh-tints. The murrey-tint is of great use in the grounds of distant objects; and the umber and dark shades in the near grounds. The greens should be more beautiful than you intend them, because they will fade and grow darker. After all is painted, go over the whole very lightly with the softener, as you did the

grounds, which will make it look agreeably finished.

Of Landscape Painting.

The principal colours used in landscapes are; 1. Flake white; 2. White lead, or common white; 3. Fine light ochre; 4. Brown ochre; 5. Brown pink; 6. Burnt umber; 7. Ivory black; 8. Prussian blue; 9. Ultramarine; 10. Terreverte; 11. Lake; 12. Indian red; 13. Vermilion, or native cinnabar; 14. King's yellow.

The principal tints are, 1. Light ochre and white; 2. Light ochre, Prussian blue, and white; 3. Light ochre, and Prussian blue; 4. The same darker; 5. Terreverte and Prussian blue; 6. Brown pink and Prussian blue; 7. Brown pink and brown ochre; 8. Brown pink, ochre, and Prussian blue; 9. Indian red and white; 10. Ivory-black, Indian red, and lake.

The colours necessary for dead-colouring, are: common white, light ochre, brown ochre, burnt umber, Indian red, ivory black, and Prussian blue.

The principal colours and tints for painting the sky, are, fine white, ultramarine, Prussian blue, light ochre, vermilion, lake, and Indian red.

The tints are, a fine azure, lighter azure, light ochre and white, vermilion and white and a tint made of white, a little vermilion, and some of the light azure, at your discretion.

Process.—Sketch or rub in your design faintly, with burnt umber used with drying oil, and a little oil of turpentine: leaving the colour of the cloth for the lights. Remember, in doing this, to leave no part of the shadows so dark as you intend the first lay or dead-colouring, which also is to be lighter than the finishing colours. Though the foliage of the trees is only rubbed in faintly, yet the trunks and bodies should be in their proper shapes, with their breadths of light and shadow. All kind of buildings should be done in the same manner, leaving the colour of the cloth for their lights. The figures on the fore-ground may also be sketched in the same manner, and then left to dry.

First Painting or Dead-colouring,

Let the first lay, or dead-colouring, be without any bright, glaring, or strong dark colours; so that the effect is made more to receive and preserve the finishing colours, than to shew them in their first painting.

The sky should be done first, then all the distances; and so work downwards to the middle group, and from that to the fore-ground, and nearest parts. Remember, all the parts of each group, as trees, buildings, or the like, are all painted with the group they belong to.

The greatest secret in dead-colouring is, to find the two colours which serve for the ground of shadows in general, the sky excepted; and the method of using them with the lights: the first of which is the dark shade with a little lake in it; the other colour is only burnt umber. These should be a little changed to the natural hue of the objects, and then laid on with drying oil, in the same manner as we shade with Indian ink, which is a kind of glazing, and as such they should be left; otherwise they will be dark and heavy, and therefore would be entirely spoiled for the finishing glazing. Both these colours mix and sympathize agreeably with all the lights, but should be laid before them.

The sky.—The sky should be laid with a good body of colours, and left with a faint resemblance of the principal clouds, more in the manner of claro obscure than with finishing colours; the whiter it is left, the better it will bear out and support them. The distances should be made out faint and obscurely, with the dark shades, and some of their lights in different degrees, and laid so as best to find and shew their principal parts. All the grounds of the trees should be laid or rubbed in, enough only to leave an idea of their shapes and shadows faintly. The ground of their shadows must be clean, and lighter than their finishing colours.

In painting the lights, it is better to incline more to the middle tint than to the very high lights; and observe to leave them with a sufficient body of clean colours, which will preserve the finishing colours better; all which may be done with a few tints. After this, go over the whole with a sweetener very lightly, which will soften and mix the colours agreeably for finishing.

Second Painting.

Begin with the sky, and lay in all the azure and colours of the horizon; then soften them; after that, lay in the general tint of the clouds, and finish on it with the high lights, and the other tints that are wanting, with light tender touches; then soften the whole with a sweeterer very lightly. The finishing of the sky should be done all at one painting, because the tender character of the clouds will not do so well as when the whole is wet. Observe, that the stiffer the azure and colours of the horizon are laid, the better the clouds may be painted upon them.

The greatest distances are chiefly made with the colour of the sky; as they grow nearer and darker, glaze and scumble the parts very thin, with such glazing shadow colours as come nearest to the general hue of the group the objects are in. This glazing should be understood of a darkish hue; and that the first painting or dead-colour should be seen through it distinctly. On this lay, or ground, add the finishing colours.

Third and last Painting.

If oiling is necessary, lay the least quantity that can be; which should be done with a stump tool or pencil, proportioned to the place that is to be oiled, so as to oil no more than is wanted: then wipe the whole place that is oiled, with a piece of silk handkerchief.

When going to finish any objects, remember to use a great variety of tints, very nearly of the same colour, but most of all when finishing trees. This gives a richness to the colouring, and produces harmony. The greens will fade, and grow darker; therefore it is highly necessary to improve and force them, by exaggerating the lights, and making a[illegible]lowance in using them so much the lighter. [illegible]or the same reason, take great care not to overcharge and spoil the beauty of the glazing; for if you do it will be dull and heavy, and will consequently grow darker

The method of painting near trees is, to make the first lay very near to nature, though not quite so dark, but more in the degree of a middle tint, and follow it with strengthening the shadows; then the middle tints; and last of all lay the high lights and finishing colours. All this cannot be done as it should be at one painting; therefore the best way is, to do no more than the first lay with the faint shadows, and leave it to dry.

Then begin with improving the middle tints and shadows, and let them dry.

The third and last work is, adding all the lights and finishing colours in the best manner you are able. This method of leaving the first and second parts to dry separately, not only makes the whole much easier, and more agreeable, but leaves the colours in the greatest perfection; because most of the work may be done with scumbling and glazing, and some parts without oiling. The lights also may be laid with a better body of colour, which will not be mixed and spoiled with the wet ground.

The figures in the landscape are the last work of the picture; those in the fore ground should be done first, and those in the distances should be done next; for after the figures in the first and farthest group are painted, it will be much easier to find the proportions of those in the middle parts of the picture. And observe, that the shadows of the figures should be of the same hue, or colour, with those of the group or place they are in.

Miniature Painting.

Miniature painting is of very ancient date, and is practised either on vellum or ivory; the colours are prepared with water, or gum. It is of all others the most delicate and tedious in its process, being performed wholly with the point of the pencil. It is only fitted for works of a small size, and must be viewed near.

Colours used in Miniature Painting.

In painting the face, the yellows that are used are five, viz. gall-stone, terra Sienna, Nottingham ochre, Roman ochre, and Naples yellow; the latter three of which are opaque colours, the other transparent. The greens are confined to one, which is sap-green. The blues are verditer, Prussian, indigo, smalt, ultramarine, and Antwerp. The reds are, carmine, drop lake, Chinese vermilion, and Indian red. Under the class of reds, may also be put burnt terra Sienna, its colour inclining much that way, though more to the orange. The only browns, if any are used in the face, are burnt umber and terra de Cassel, and they are only to be used in the mixture of dark shades.

For painting draperies, we shall only add to the above colours, lamp-black, king's-yellow, and flake-white.

From the variety of style adopted by different miniature painters, it is very difficult for a young beginner to ascertain which is best to be followed; and as there is a certain degree of mechanical attention to be paid to the management of the water colours, to preserve them clear and free from muddiness, which is difficult to attain, we recommend to the young artist to procure a good miniature, if possible, and keep it by him, observing the style of pencilling and management of the colour, at the same time letting nature be his guide in the marking of his features and colouring of his picture.

In the management of back grounds, the young painter is to observe their two-fold purpose: that of giving the lights their proper value; and on the other hand, of harmonizing the colours of the face, by artfully engaging the eye with somewhat of similitude in the back-ground to a tint in the face, which otherwise, in course of working to express a particular part, might appear too prevalent.

In painting a head, on an oval piece of ivory, such as the present form of a miniature picture, draw the chin as nearly as possible in the centre of the ivory, unless the person is very tall, in which case it must be higher up; and if very short, the contrary.

Mosaic Painting.

This wonderful branch of art, improperly called painting, almost defying the hand of time, has been practised in many countries; but the finest works of their kind, and those by which the moderns have retrieved the art, which was in a manner lost, are those in the church of St. Agnes, formerly the temple of Bacchus, at Rome, at Pisa, Florence, and other cities of Italy.

The most esteemed among the works of the moderns are those of the church of St. Peter, at Rome. There are also very good ones at Venice.

Mosaic work is composed of small pieces of glass, marble, precious stones, &c. of various colours, cemented on a ground of stucco or mortar, in imitation of painting. It is generally employed in copying original pictures of the highest value in the art.

In performing this work, it is requisite to provide little pieces of glass of as many different colours as can possibly be got.

For this purpose a glass-maker's furnace being prepared, and the pots and crucibles full of the matter of which glass is made, put into each crucible what colour you require, always beginning with the weakest, and augmenting the strength of the colour from crucible to crucible till you come to the deepest tincture.

When the glass has been thoroughly concocted, and the colours are in their perfection, take out the glass, hot as it is, and pour it on a smooth marble, flatting it down with another similar marble, and then cut it into slices of equal sizes, and about the thickness of an inch and a half.

Then with an instrument, which the Italians call bocca di cane, you must make some pieces square, and others of different forms and sizes, as occasion requires. These pieces are to be orderly disposed in cases, as in painting in fresco. It is usual to range all the different tints in shells, and according to their colour

If it is desired to have gold, either in the ground of the painting, or in the ornaments or draperies, take some of the pieces of glass, formed and cut in the manner before mentioned; moisten these on one side with gum-water, and afterwards lay them over with leaf-gold; then put this piece, or several pieces at a time, on a fire-shovel, and place it in the mouth of a furnace, after you have first covered them with another hollow piece of glass.

Let these stand till they are just red-hot, then draw the shovel out all at once, and the gold will become so firmly attached to the glass, that it will never afterwards come off.

Now in order to apply these several pieces, and out of them, to form a picture, in the first place provide a cartoon or design, as this is to be transferred to the ground or plaster by calking, as in painting in fresco. See FRESCO.

As the plaster is to be laid thick on the wall, and therefore will continue fresh and soft for a considerable time, there may be enough prepared at once to serve for as much work as will take up three or four days.

This plaster is composed of lime made of hard stone, with brickdust very fine, gum tragacanth, and whites of eggs; and having been thus prepared and laid on the wall, and the design of what is to be represented transferred to it, take out the little pieces of glass with a pair of pliers, and range them one after another, still keeping strictly to the light shadow, different tints and colours which are to be represented; pressing or flatting them down with a ruler, which serves both to sink them within the ground, and to render the surface even.

A long time and tedious labour are requisite to finish the work, which will be more beautiful as the pieces of glass are more uniform and ranged at an even height.

Pieces of mosaic work performed with exactness appear as smooth as a table of marble, and as finished and masterly as a painting in fresco, with this advantage, that they have a fine lustre, and will last for ages.

Mosaic Work of Marble, and precious Stones.

These two kinds of mosaic bear so near a resemblance to each other, as to the manner of working, that to avoid repetition, we shall give them both under one, taking notice as we proceed, wherein the one differs from the other, either in the sawing or the ranging of the stones.

Mosaic work of marble is used in large works, as in pavements of churches and palaces, and in the incrustation and veneering of the walls of edifices of the same kind.

Mosaic of precious stones is only used in small works, as ornaments for altar-pieces, tables for cabinets, &c. on account of the exceeding price of the materials.

Process of Mosaic Painting.

The ground of mosaic works wholly marble, is usually a massive marble, either white or black.

On this ground the design is cut with a chisel, after it has been first chalked.

After it has been cut of a considerable depth, *i. e.* an inch or more, the cavities are filled up with marble of a proper colour, (first selected according to the colours of the design, or original picture to be copied,) and reduced to the thickness of the indentures with various instruments.

To make the pieces thus inserted into the indentures cleave fast, (whose several colours are to imitate the tints of the original design,) a stucco is composed of lime and marble-dust, or a kind of mastic, which is prepared by each workman after a different manner peculiar to himself.

The figures being marked out, the painter or sculptor himself draws with a pencil the colours of the figures not determined by the ground, and in the same manner makes strokes or hatchings in the place where shadows are to be; and after he has engraven with the chisel all the strokes thus drawn, he fills them up with a black mastic, composed partly of Burgundy pitch poured on hot, taking off afterwards what is superfluous with a piece of soft stone or brick, which, together with water and beaten cement, takes away the mastic, polishes the marble, and renders the whole so even that one would imagine it only consisted of one piece.

This is the kind of mosaic work that is seen in the church of the Invalids in Paris, and the chapel at Versailles, and with which some entire apartments of that palace are incrustated.

As for mosaic work of precious stones, other and finer instruments are required than those used in marble, as drills, wheels, &c. used by lapidaries, and engravers on stone.

As none but the richest marbles and stones are used in this work, to make them go the further they are sawn into the thinnest slices or coats imaginable, scarce exceeding half a line in thickness: the block to be sawn is fastened firmly with cords on the bench, and only raised a little on a piece of wood one or two inches high.

Two iron pins, which are on one side of the block, and which serve to fasten it, are put into a vice contrived for the purpose; and with a kind of saw or bow, made of fine brass wire bent on a piece of spungy wood, together with emery steeped in water, the slice is gradually fashioned by following the stroke of the design made on paper, and glued on the piece.

When there are pieces enough fastened to form any one entire part of the design, they are applied to the ground.

The ground which supports this mosaic work is usually of free-stone.

The matter with which the stones are joined together is a mastic, or a kind of stucco, laid very thin on the slices of marble, &c. as they are fashioned; this being done, the slices are applied with pliers; and if in any part they are not either square or rounded sufficiently, so as to fit the place exactly into which they are to be inserted, they are brought down, when too large, with a brass file or rasp; and when too little, a drill, and other instruments, used by lapidaries, are used to supply the deficient part.

PAKFONG. The white copper of the Chinese, said to be an alloy of copper, nickel, and zinc; in 16 parts of which there are 7 of zinc, 2½ of copper, and 6½ of nickel. The combination of zinc and nickel simply does not succeed.

PALÆSTRA, in Grecian antiquity, a public building, where the youth exercised themselves in wrestling, running, playing at quoits, &c.

PALAMEDEA, a genus of birds belonging to the order of grallæ. The character of this genus is, the bill bends down at the point with a horn, or with a tuft of feathers erect near the base of it; the nostrils are oval; the toes are divided almost to their origin, with a small membrane between the bottoms of each.

PALATE. See ANATOMY.

PALATINE COUNTIES, are those of Chester, Durham, and Lancaster.

PALE, a little pointed stake or piece of wood, used in making inclosures, separations, &c. The pale was an instrument of punishment, and execution, among the ancient Romans, and still continues so among the Turks. Hence, empaling, the passing a sharp pale up the fundament through the body.

Pale, in heraldry, one of the honourable ordinaries of an escutcheon; being the representation of a pale or stake placed upright, and comprehending the whole height of the coat from the top of the chief to the point.

PALISADE, or **Palisado**, in fortification, an inclosure of stakes or piles driven into the ground, each six or seven inches square, and eight feet long, three whereof are hidden under ground. Palisadoes are generally used to fortify the avenues of open forts, gorges, half-moons, the bottoms of ditches, the parapets of covert ways, and in general all posts liable to surprise, and to which the access is easy.

PALLADIUM. See Chemistry.

PALLET, among painters, a little oval table, or piece of wood, or ivory, very thin and smooth; on, and round which, the painters place the several colours they have occasion for, to be ready for the pencil. The middle serves to mix the colours on, and to make the tints required in the work. It has no handle, but instead thereof a hole at one end to put the thumb through to hold it.

Pallet, among potters, crucible makers, &c. a wooden instrument, almost the only one they use, for forming, beating, and rounding their works; they have several kinds: the largest are oval, with a handle; others are round, or hollowed triangularly; others, in fine, are in manner of large knives, serving to cut off whatever is superfluous on the moulds of their work.

Pallet, in gilding, an instrument made of a squirrel's tail, to take up the gold leaves from the pillow, and to apply and extend them on the matter to be gilt. See Gilding.

Pallet, in heraldry, is nothing but a small pale, consisting of one half of it in breadth, and therefore there are sometimes several of them upon one shield.

Pallet is also a part belonging to the balance of a watch or movement. See Watch.

PALM, a measure in length of about three inches.

PALMÆ, in botany, *palms*. Under this name Linnæus has arranged several genera, which he has placed apart in an appendix to the work. The same plants constitute one of the seven families or tribes into which all vegetables are distributed by Linnæus in his "Philosophia Botanica." They are defined to be plants with simple stems, which, at their summit, bear leaves resembling those of the ferns, being the composition of a leaf and a branch; and whose flowers and fruit are produced on that particular receptacle, or seat, called a spadix, protruded from a common calyx in form of a sheath or scabbard, termed by Linnæus "spatha."

PANAX, **Ginseng**, a genus of the diœcia order, in the polygamia class of plants. In the umbel the corolla is five-petalled; stamina five; hermaphrodite calyx five-toothed; superior styles two; berry two-seeded; male calyx entire. There are nine species of this plant: 1. Quinquefolia; 2. Trifolia; 3. Fruticosa; 4. Arborea; 5. Spinosa; 6. Aculeata; 7. Chrysophylla; 8. Simplex; 9. Attenuata.

PANCRATIUM, a genus of the hexandria monogynia class of plants, the flower of which consists of six lanceolated petals; its nectarium is twelve-cleft; stamina placed on the nectary There are ten species, beautiful flowering plants, with large bulbs.

PANCREAS. See Anatomy.

PANDANUS, a genus of the diœcia monandria class and order. There is no calyx or corolla; male anther sessile; female stigmas two; fruit compound. There is one species.

PANDECTS, in the civil law, collections made by Justinian's order of 534 decisions of the ancient lawyers, on so many questions occurring in the civil law; to which that emperor gave the force and authority of law, by an epistle prefixed to them The pandects consist of fifty books, and make the first part of the body of the civil law.

PANEL, in law. See Jury.

PANICUM, a genus of the digynia order, in the triandria class of plants. The calyx is trivalved, the third valvule being very small. The species are in number seventy-nine, grasses of different countries.

PANNEL, in law. In the Scotch law, pannel signifies the prisoner at the bar, or person who takes his trial before the court of justiciary, for son

Pannel, in joinery, is a tympanum, or square piece of thin wood, sometimes carved, framed, or grooved in a larger piece, between two upright pieces and two cross pieces.

Pannel, in masonry, is one of the faces of a hewn stone.

PANTHER. See Felis.

PAPAVER, the *poppy*, a genus of the monogynia order, in the polyandria class of plants, and in the natural method ranking under the 27th order, rhœadæ. The corolla is tetrapetalous; the calyx diphyllous; the capsule bilocular, opening at the pores below a persisting stigma. There are nine species: 1. The somniferum, or somniferous common garden-poppy. There are of this a great many varieties, some of them extremely beautiful. The white official poppy is one of the varieties of this sort. It grows often to the height of five or six feet, having large flowers, both single and double, succeeded by capsules or heads as large as oranges, each containing about 8000 seeds.

PAPER, sheets of a thin matter, made of some vegetable substance. The materials on which mankind have, in different ages, contrived to write their sentiments, have been extremely various; in the early ages they made use of stones and tables of [illegible], wax, ivory, &c. Paper, with regard to the manner of making it, and the materials employed therein, is reducible to several kinds; as Egyptian paper, made of the rush papyrus; bark paper made of the inner rind of several trees; cotton paper; incombustible paper; and European paper, made of linen rags.

Linen or European paper appears to have been first introduced among us towards the beginning of the fourteenth century, but by whom this valuable commodity was invented is not known. The method of making paper of linen or hempen rags is as follows:—the linen rags, being carried to the mill, are first sorted: instead of the old method of pounding the rag to

a pulp with large hammers, they now make use of an engine, which performs the work in much less time. This engine consists of a round solid piece of wood, into which are fastened long pieces of steel, ground very sharp. This is placed in a large trough with the rags, and a sufficient quantity of water. At the bottom of the trough is a plate with steel bars, ground sharp like the former; and the engine, being carried round with prodigious velocity, cuts and reduces the rags to a pulp in a very short time. It must be observed, that the motion of the engine causes the water in the trough to circulate, and by this means constantly returns the stuff to the engine. The trough is constantly fed with clear water at one end, while the dirty water from the rags is carried off at the other, through a hole defended with wire gratings, in order to hinder the pulp from going out with the dirty water. When the stuff is sufficiently prepared as above, it is carried to the vat, and mixed with a proper quantity of water, which they call *priming the vat.* The vat is rightly primed when the liquor has such a proportion of the pulp, as that the mould, on being dipped into it, will just take up enough to make a sheet of paper of the thickness required. The mould is a kind of sieve, exactly of the size of the paper to be made, and about an inch deep, the bottom being formed of fine brass wire, guarded underneath with sticks, to prevent its bagging down, and keep it horizontal; and further to strengthen the bottom, there are large wires, placed in parallel lines, at equal distances, which form those lines often visible in white paper when held up to the light: the mark of the paper is also made in this bottom, by interweaving a large wire in any particular form. This mould the maker dips into the liquor, and gives it a shake as he takes it out, to clear the water from the pulp. He then slides it along a groove to the coucher, who turns out the sheet upon a felt or woollen cloth laid upon a plank, lays another cloth on it, and returns the mould to the maker, who by this time has prepared a second sheet in another mould: and thus they proceed, laying alternately a sheet and a felt, till they have made six quires of paper, which is called a post; and this they do with such swiftness, that, in many sorts of paper, two men make twenty posts or more in a day. A post of paper being made, either the maker or coucher whistles; on which four or five men advance, one of whom draws it under the press, and the rest press it with great force, till all the water is squeezed from it; after which it is separated, sheet by sheet, from the felts, and laid regularly [illegible] sheet upon another; and having underg[illegible] a second pressing, it is hung up to dry. When sufficiently dried it is taken off the lines, rubbed smooth with the hands, and laid by till sized, which is the next operation. For this they choose a fine temperate day, and having boiled a proper quantity of clean parchment or vellum shavings, in water, till it comes to a size, they prepare a fine cloth, on which they strew a due proportion of white vitriol and roch-alum, finely powdered, and strain the size through it, into a large tub; in which they dip as much paper at once as they can conveniently hold, and with a quick motion give every sheet its share of the size, which must be as hot as the hand can well bear it. After this the paper is pressed, hung up sheet by sheet to dry; and, being taken down, is sorted, and what is only fit for outside quires, laid separately: it is then told into quires, which are folded and pressed. The broken sheets are commonly put together, and two of the worst quires are placed on the outside of every ream or bundle, and being tied up in wrappers, made of the settling of the vat, it is fit for sale

Paper is of various kinds, and used for various purposes: with regard to colour, it is principally distinguished into white, blue, and brown; and with regard to its dimensions, into atlas, elephant, imperial, super-royal, royal, medium, demy, crown, foolscap, and pot paper.

PAPIER MACHE, is a substance made of cuttings of white or brown paper, boiled in water, and beaten in a mortar till they are reduced into a kind of paste; and then boiled with a solution of gum arabic or of size, to give tenacity to the paste, which is afterwards formed into different toys, &c. by pressing it into oiled moulds. When dry, it is covered with a mixture of size and lamp-black, and afterwards varnished.

PAPILIO, *butterfly*, a genus of insects of the order lepidoptera. The generic character is, antennæ thickening towards the extremity, commonly terminating in a knob or elevated tip; wings (when sitting) erect, and meeting upwards: flight diurnal.

The prodigious number of species, amounting to many hundreds, in this genus, renders it absolutely necessary to divide the whole into sections or sets, instituted from the habit or general appearance, and, in some degree, from the distribution of colour on the wings. This division of the genus is conducted by Linnæus in a peculiarly elegant and instructive manner, being an attempt to combine, in some degree, natural and civil history, by attaching the memory of some illustrious ancient name to an insect of a certain particular cast.

PAPISTS, persons professing the popish religion. By several statutes, if any English priest of the church of Rome, born in the dominions of the crown of England, came to England from beyond the seas, or tarried in England three days without conforming to the church, he was guilty of high treason; and they also incurred the guilt of high treason who were reconciled to the see of Rome, or procured others to be reconciled to it. By these laws also, papists were disabled from giving their children any education in their own religion. If they educated their children at home, for maintaining the schoolmaster, if he did not repair to church, or was not allowed by the bishop of the diocese, they were liable to forfeit £10 a month, and the schoolmaster was liable to the forfeiture of 40s. a day; if they sent their children for education abroad, they were liable to forfeit £100, and the children so sent were incapable of inheriting, purchasing, or enjoying any lands, profits, goods, debts, legacies, or sums of money: saying mass was punishable by a forfeiture of 200 marks; and hearing it by a forfeiture of £100. But, during the late reign, the Roman Catholics have been in some measure relieved from many of the odious and unjust restrictions formerly imposed

on them. See 18 Geo. III. c. 60: and 31 Geo. III. c. 22.

Yet as the statute 1 William and Mary, st. 1, c. 18, called the Toleration Act, does not apply to Catholics, nor to persons denying the Trinity, they cannot serve in corporations, and are liable to the Test and Corporation Act. They cannot sit in the House of Commons, nor vote at elections, without taking the oath of supremacy, and cannot present to advowsons, although Jews and Quakers may. But the person is only disabled from presenting, and still continues patron. It seems they may serve on juries, but Catholic ministers are exempted. They also are entitled to attend the British factories and their meetings abroad, and may hold offices to be wholly exercised abroad, and may also serve under the East India Company, or in the army abroad, and the 60th regiment is chiefly composed of persons who cannot serve in England, by reason of the officers.

PAPOPHORUM, a genus of the class and order triandria digynia. The calyx is two-valved, two-flowered; corolla two-valved, many-awned. There is one species, a grass of America.

PAPUS, *down* See *Botany*.

PAR, in commerce. See *Exchange*.

PARABOLA, in geometry, a figure arising from the section of a cone, when cut by a plane parallel to one of its sides. See *Conic Sections*.

PARABOLIC CONOID, in geometry, a solid generated by the rotation of a parabola about its axis: its solidity is $= \frac{1}{2}$ of that of its circumscribing cylinder. The circles conceived to be the elements of this figure, are in arithmetical proportion, decreasing towards the vertex.

A parabolic conoid is to a cylinder of the same base and height as 1 to 3; and to a cone of the same base and height as 1½ to 1. See *Gauging*.

PARABOLIC *Space*, the area contained between any entire ordinate and the curve of the incumbent parabola.

The parabolic space is to the rectangle of the semi-ordinate into the abscis, as 2 to 3; to a triangle inscribed on the ordinate as a base, it is as 4 to 3.

PARABOLOIDES, a name given to parabolas of the higher kind, which are algebraic curves.

PARACENTRIC MOTION, in astronomy, denotes so much as a revolving planet approaches nearer to, or recedes from, the sun, or centre of attraction.

PARADE, in war, is a place where the troops meet to go upon guard, or any other service. In a garrison where there are two, three, or more regiments, each have their parade appointed, where they are to meet upon all occasions, especially upon any alarm. And in a camp, all parties, convoys, and detachments have a parading place appointed them at the head of some regiment.

PARADISEA, *the bird of Paradise*, in natural history, a genus of birds of the order Picæ. Generic character, bill covered at the base with downy feathers; nostrils covered by the feathers; tail of ten feathers, two of them in some species, very long; legs and feet very large and strong. These birds chiefly inhabit North Guinea, from which they migrate in the dry season into the neighbouring islands. They are used in these countries as ornaments for the head-dress, and the Japanese, Chinese, and Persians, import them for the same purpose. —The rich and great among the latter attach these brilliant collections of plumage not only to their own turbans, but to the housings and harnesses of their horses. They are found only within a few degrees of the equator. Gmelin enumerates twelve species, and Latham eight. P. apoda, or the greater Paradise bird is about as large as a thrush.

These birds are supposed to breed in North Guinea whence they migrate into Aroo, returning to North Guinea with the wet monsoon. They pass in flights of thirty or forty, headed by one whose flight is higher than that of the rest. They are often distressed by means of their long feathers in sudden shiftings of the wind, and unable to proceed in their flight, are easily taken by the natives, who also catch them with birdlime, and shoot them with blunted arrows. They are sold at Aroo for an iron nail each, and at Banda for half a rix dollar. Their food is not ascertained, and they cannot be kept alive in confinement. The smaller bird of Paradise is supposed by Latham to be a mere variety of the above. It is found only in the Papuan islands, where it is caught by the natives often by the hand, and exenterated and seared with a hot iron in the inside, and then put into the hollow of a bamboo to secure its plumage from injury.

PARADOX, in philosophy a proposition seemingly absurd, as being contrary to some received opinion; but yet true in fact.

PARAGOGE, in grammar, a figure whereby a letter or syllable is added to the end of a word; as *med*, for *me*; *dicier*, for *dici*, &c.

PARALACTIC, in general, something relating to the parallax of heavenly bodies. See *Parallax*.

PARALLAX, in astronomy, denotes a change of the apparent place of any heavenly body, caused by being seen from different points of view; or it is the difference between the true and apparent distance of any heavenly body from the zenith.

PARALLAX, *annual*, the change of the apparent place of a heavenly body, which is caused by being viewed from the earth in different parts of its orbit round the sun.

PARALLEL, in geometry, an appellation given to lines, surfaces, and bodies, every where equidistant from each other; and which, though infinitely produced, would never meet.

PARALLEL RULER, an instrument, consisting of two wooden, brass, &c. rul[illegible], equally broad everywhere; and so joined together by cross blades as to open to different intervals, accede and recede, and yet still retain their parallelism.

PARALLELS *of latitude*, in astronomy, are lesser circles of the sphere parallel to the ecliptic, imagined to pass through every degree and minute of the colures.

PARALLELS *of altitude*, or Almucantars, are circles parallel to the horizon, imagined to pass through every degree and minute of the meridian between the horizon and zenith, having their poles in the zenith. They are represented on the globe by the divisions on the quadrant of altitude, in its motion about the body of the globe, when screwed to the zenith.

Parallels *of declination*, in astronomy, are the same with parallels of latitude in geography.

Parallel sphere, that situation of the sphere, wherein the equator coincides with the horizon, and the poles with the zenith and nadir. In this sphere all the parallels of the equator become parallels of the horizon, consequently no stars ever rise or set, but all turn round in circles parallel to the horizon; and the sun, when in the equinoctial, wheels round the horizon the whole day. After his rising to the elevated pole, he never sets for six months; and after his entering again on the other side of the line, never rises for six months longer.

This is the position of the sphere to such as live under the poles, and to whom the sun is never higher than 23° 30′.

Parallel sailing, in navigation, is the sailing under a parallel of latitude. See Navigation.

PARALLELEPIPED, or **Parallelopiped**, in geometry, a regular solid comprehended under six parallelograms, the opposite ones whereof are similar, parallel, and equal. See Geometry.

PARALLELOGRAM. See *Geometry*.

PARALLOGISM, in logic, a false reasoning, or a fault committed in demonstration, when a consequence is drawn from principles that are false; or, though true, are not proved; or when a proposition is passed over that should have been proved by the way.

PARALYSIS the palsy. See *Medicine*.

PARAMETER, in conic sections, a constant line, otherwise called latus rectum. See Conic Sections.

PARAPET, in fortification, an elevation of earth designed for covering the soldiers from the enemy's cannon or small shot. The thickness of the parapet is from 18 to 20 feet; its height is six feet on the inside, and four or five on the outside.

PARAPHRASE, an explanation of some text, in clearer and more ample terms, whereby is supplied what the author might have said or thought on the subject; such are esteemed Erasmus's Paraphrase on the New Testament, the Chaldee Paraphrase on the Pentateuch, &c.

PARASANG, an ancient Persian measure, different at different times, and in different places; being sometimes 30, sometimes 40, and sometimes 50 stadia or furlongs.

PARASITES, or **Parasitical Plants**, in botany, such plants as are produced out of the trunk or branches of other plants, from whence they receive their nourishment, and will not grow upon the ground, as the misleto, &c.

PARCEL-MAKERS, two officers in the exchequer, who make parcels of the escheator's accounts, in which they charge them with every thing they have levied for the king's use, within the time of their office, and deliver the same to one of the auditors of the court, to make their accounts therewith.

PARCHMENT, in commerce, the skin of sheep or goats prepared after such a manner as to render it proper for writing upon, covering books, &c.

PARDON, is the remitting or forgiving a felony or other offence committed against the king. Blackstone mentions the power of pardoning offences to be one of the greatest advantages of monarchy, in general, above every other form of government, and which cannot subsist in democracies. Its utility and necessity are defended by him on all those principles which do honour to human nature.

Pardons are either general or special: general, as by act of Parliament, of which, if they are without exceptions, the court must take notice, *ex officio;* but if there are exceptions therein, the party must aver, that he is none of the persons excepted: special pardons, are either of course, as to persons convicted of manslaughter, or *se defendendo*, and by several statutes, to those who shall discover their accomplices in several felonies; or of grace, which are by the king's charter, of which the court cannot take notice, *ex officio*, but they must be pleaded. A pardon may be conditional, that is, the king may extend his mercy upon what terms he pleases; and may annex to his bounty a condition, either precedent or subsequent, on the performance whereof, the validity of the pardon will depend; and this by the common law.

All pardons must be under the great seal. The effect of a pardon is to make the offender a new man; to acquit him of all corporal penalties and forfeitures annexed to that offence, and to give him a new credit and capacity; but nothing but an act of Parliament can restore or purify the blood after an attainder.

PAREGORICS, medicines that assuage pain, otherwise called anodynes.

PARENTHESIS, in grammar, certain intercalary words, inserted in a discourse; which interrupt the sense or thread, but seem necessary for the better understanding of the subject.

PARENTS AND CHILDREN. If parents run away, and leave their children at the charge of the parish, the churchwardens and overseers, by order of the justices, may seize the rents, goods, and chattels, of such parents, and dispose thereof towards their children's maintenance.

A parent may lawfully correct his child, being under age, in a reasonable manner; but the legal power of the father over the persons of his children, ceases at the age of 21. 1 Black. 452.

PARHELION. See Optics.

PARISH. In England there are 9913 parishes, of which 3845 are churches impropriate, and the rest are annexed to colleges or church dignities. In many of these parishes, on account of their large extent and the number of parishioners, there are several chapels of ease.

Parish *clerk*. In every parish the parson, vicar, &c. hath a parish clerk under him, who is the lowest officer of the church. These were formerly clerks in orders, and their business at first was to officiate at the altar, for which they had a competent maintenance by offerings; but now they are laymen, and have certain fees with the parson on christenings, marriages, burials, &c. besides wages for their maintenance.

PARLIAMENT. The parliament is the legislative branch of the supreme power of Great Britain, consisting of the King, the Lords spiritual and temporal, and the Knights, Citizens, and Burgesses, representatives of the Commons of the Realm, in Parliament assembled.

The power and jurisdiction of Parliament is so transcendant and absolute that it cannot be confined, either for causes or persons, within any bounds.

The Parliament must be summoned by the King, and not by authority of either house, at least forty days before it sits, although the Convention Parliament (the House of Commons), from necessity, was summoned by the Keepers of the Liberty of England, by authority of Parliament. It cannot begin without the King in person, or by representation.

The house of Commons is a denomination given to the lower house of parliament. In a free state, every man, who is supposed a free agent, ought to be, in some measure, his own governor; and therefore a branch at least of the legislative power should reside in the whole body of the people. In elections for representatives for Great Britain, anciently, all the people had votes; but king Henry VI. to avoid tumults, first appointed that none should vote for knights but such as were freeholders, did reside in the county, and had forty shillings yearly revenue. In so large a state as ours, therefore, it is very wisely contrived, that the people should do that by their representatives which it is impracticable to perform in person; representatives chosen by a number of minute and separate districts, wherein all the voters are or may be easily distinguished. The counties are therefore represented by knights, elected by the proprietors of lands; the cities and boroughs are represented by citizens and burgesses, chosen by the mercantile or supposed trading interest of the nation.

The number of members returned to Parliament from England, Scotland, and Ireland, is 658.

The peculiar laws and customs of the House of Commons, relate principally to the raising of taxes, and the election of members to serve in Parliament.

The method of making laws is nearly the same in both houses. In the House of Commons, in order to bring in the bill, if the relief sought is of a private nature, it is first necessary to prefer a petition; which must be presented by a member, and usually set forth a grievance required to be remedied. This petition, when founded on facts of a disputable nature, is referred to a committee of members, who examine the matter alleged, and accordingly report it to the house; and then (or otherwise upon the mere petition), leave is given to bring in the bill. In public matters, the bill is brought in upon motion made to the house, without any petition.

If the bill begins in the House of Lords, if of a private nature, it is referred to two judges, to make report. After the second reading, the bill is said to be committed, that is, referred to a committee; which is selected by the house, in matters of small importance; or upon a bill of consequence, the house resolves itself into a committee of the whole house. A committee of the whole house is composed of every member; and to form it the speaker quits the chair, and may consequently sit and debate upon the merits of it as a private member, another member being appointed chairman for the time. In these committees the bill is usually debated clause by clause, amendments made, and sometimes it is entirely new-modelled. Upon the third reading, further amendments are sometimes made; and if a new clause is added, it is done by tacking a separate piece of parchment on the bill, which is called a rider.

The royal assent must be given to the bill before it can pass into a law; and this is done by letters patent under the king's seal, and signed with his own hand.

An act of parliament thus made is the exercise of the highest authority that this kingdom acknowledges upon the earth.

Adjournment is no more than a continuance of the session from one day to another, as the word itself signifies; and this is done by the authority of each house separately every day, or for a longer period; but the adjournment of one house is no adjournment of the other. 1 Black. 186.

Prorogation is the continuance of the parliament from one session to another, as an adjournment is a continuation of the session from day to day. And this is done by the royal authority, expressed either by the lord chancellor in his majesty's presence, or by commission from the crown, or frequently by proclamation; and by this, both houses are prorogued at the same time, it not being a prorogation of the house of lords or commons, but of the parliament. The session is never understood to be at an end until a prorogation; though, unless some act is passed, or some judgment given in parliament, it is in truth no session at all. Id.

A dissolution is the civil death of the parliament; and this may be effected three ways: 1. By the king's will expressed either in person or representation; 2. By the demise of the crown; 3. By the length of time.

By the king's will; for, as the king has the sole right of convening the parliament, so also it is a branch of the royal prerogative, that he may whenever he pleases, prorogue the parliament for a time, or put a final period to its existence.

By the demise of the crown: this dissolution formerly happened immediately upon the death of the reigning sovereign; but the calling a new parliament immediately on the inauguration of the successor being found inconvenient, and dangers being apprehended from having no parliament in being, in case of a disputed succession, it was enacted by statutes 7 and 8 W. III. c. 15, and 6 Anne, c. 7, that the parliament in being shall continue for six months after the death of any king or queen, unless sooner prorogued or dissolved by the successor; that if the parliament is at the time of the king's death separated by adjournment or prorogation, it shall notwithstanding assemble immediately; and that if no parliament is then in being, the members of the last parliament shall assemble and be again a parliament.

Lastly, a parliament may be dissolved or expire by length of time.

The utmost extent of time that the same parliament was allowed to sit by the stat. of 6 W. c. 3. was three years; after the expiration of which, reckoning from the return of the first summons, the parliament was to have no longer continuance. But by stat. 1. Geo. I. c. 38. in order professedly to prevent the great and continued expences of frequent elections, and the violent heats and animosities consequent

thereupon, and for the peace and security of the government just then recovering from the late rebellion, this term was prolonged to seven years. So that as our constitution now stands, the parliament must expire, or die a natural death, at the end of every seventh year, if not sooner dissolved by the royal prerogative. See Election.

Parliament, *the high court of*, is the supreme court of the kingdom, not only for the making but also for the execution of laws, by the trial of great and enormous offenders, whether lords or commoners, in the method of parliamentary impeachment. An impeachment before the lords, by the commons of Great Britain in parliament, is a prosecution of the already known and established law, and has been frequently put in practice; being a presentment to the most high and supreme court of criminal jurisdiction by the most solemn grand inquest of the whole kingdom. A commoner cannot, however, be impeached before the lords for any capital offence, but only for high misdemeanors; a peer may be impeached for any crime. And they usually, in case of an impeachment of a peer for treason, address the crown to appoint a lord high steward, for the greater dignity and regularity of their proceedings: which high steward was formerly elected by the peers themselves, though he was generally commissioned by the king; but it has of late years been strenuously maintained, that the appointment of a high steward in such cases is not indispensably necessary, but the house may proceed without one. The articles of impeachment are a kind of bills of indictment, found by the house of commons, and afterwards tried by the lords; who are in cases of misdemeanors considered not only as their own peers, but as the peers of the whole nation.

PARODY, a popular maxim, adage, or proverb. Parody is also a poetical pleasantry, consisting in applying the verses written on one subject, by way of ridicule to another; or in turning a serious work into a burlesque, by affecting to observe, as nearly as possible, the same rhymes, words, and cadences.

PAROLE, a term signifying any thing done verbally or by word of mouth in contradistinction to what is written: thus, an agreement may be by parole. Evidence also may be divided into parole evidence and written evidence. A parole release is good to discharge a debt by simple contract.

PARROT, and **PARROQUET**. See Psittachus.

PARSLEY. See Apium.

PARSNEP. See Pastinaca.

PARSON, signifies the incumbent of a church. He is in himself a body corporate, in order to protect and defend the rights of the church by a perpetual succession. When a parson is instituted and inducted into a rectory, he is then, and not before, in full and complete possession. 1 Black. 391.

PART, in music, the name of each of the melodies of any harmonic composition, and which, when performed in union, form its harmony. Four is the fewest number of parts with which the chords necessary to elaborate harmony can be completely filled.

PARTERRE, in gardening, a level division of ground, which, for the most part, faces the south, and best front of a house; and is generally furnished with greens, flowers, &c.

PARTICIPLE. See Grammar.

PARTICLE, in grammar, a denomination for all those small words that tie or unite others together, or that express the modes or manners of words.

PARTIES, in law, signify the persons that are named in a deed or fine, viz. those that made the deed, or levied the fine, and also those to whom the same was made or levied.

PARTITION, in law, signifies a division of lands, &c. descended by common law or custom among coheirs or parceners, being two at least.

PARTNER. If there are several joint partners, and a person has dealings generally with one of them in matters concerning their joint trade, whereby a debt becomes due to the said person, it shall charge them jointly and the survivors of them; but if the person only dealt with one of the partners upon a separate account, in that case the debt shall only affect that partner and his executors. If one or more of the joint traders become bankrupt, his or their proportions are only assignable by the commissioners, to be held in common with the rest who are not bankrupts. If one or two partners becomes a bankrupt, the commissioners cannot meddle with the interest of the other, for it is not affected with the bankruptcy of his companion. Payment to one of the partners is payment to them all.

PART-OWNERS, are partners interested and possessed of certain shares in a ship. Owners are tenants in common with each other; but one or more joint-owners refusing to contribute their quota to the outfit of the vessel, cannot prevent her from going to sea against the consent of the majority of the owners, who, giving security in the Admiralty, may freight the ship at their own exclusive risk, by which the smaller dissentient number of owners will be excluded at once from any share, either in the risk or in the profits.

PARTRIDGE. See Tetrao.

PARUS, or Titmouse, in ornithology, a genus belonging to the order of passeres. The bill is very entire, covered at the basis with hairs; the tongue is truncated and hairy. There are 14 species.

PASQUIN, a mutilated statue at Rome, in a corner of the palace of the Ursini: it takes its name from a cobler of that city called Pasquin, famous for his sneers and gibes, and who diverted himself with passing his jokes on all the people who went through that street.

PASS, a straight, difficult, and narrow passage, which shuts up the entrance into a country. The first care of the general of an army is to seize the passes of the country into which he would carry the war, to fortify them, and take care that they are well guarded.

PASSAGE, or Passo, any phrase or short portion of any air, or other composition.

Passage, *birds of*. See Migration.

PASSANT. See Heraldry.

PASSERES, in natural history, the sixth order of birds according to the Linnæan system, they are distinguished by a conical and pointed bill; nostrils oval, pervious, naked; legs formed for hopping; toes slender, divided,

body slender, flesh of such as feed on grain pure; of those which feed on insects impure; nest formed with much art. They live chiefly in trees and hedges, are monogamous, vocal, and feed the young by thrusting the food down their throats.

PASSIONS, in painting: the passions are properly considered as subjects of painting, because being capable of representation by lines and colours, they fall within the province of that art, whose office it is to delineate all objects which can be expressed by those means. To represent the passions justly and fully, is, however, the utmost reach of the imitative art. The nicest accuracy is requisite, and the smallest deviation is frequently destructive of the whole effect intended to be produced.

Le Brun, a celebrated French painter, published a collection of heads, in which he gave examples of the appearances produced in the countenance by each distinct passion But these examples are for the most part overcharged and gross.

PASSPORT, or PASS, a licence or writing obtained from a prince or governor, granting liberty and safe conduct to pass through his territories without molestation. Passport also signifies a licence obtained for importing contraband goods, or for exporting and importing merchandize without paying the duties; these last licences are always given to ambassadors and other public ministers for their baggage, equipage, &c.

PASTE, in the glass trade, a kind of coloured glass, made of calcined crystal, lead, and metallic preparations, so as to imitate the natural gems: for the manner of effecting which see GEMS.

PASTEBOARD, a kind of thick paper formed of several sheets of paper pasted together. The chief use of pasteboard is in binding books, making letter-cases, &c.

PASTINACA, the *parsnip*, a genus of the digynia order, in the pentandria class of plants, and in the natural method ranking under the 45th order, umbellatæ. The fruit is an elliptical compressed plane; the petals are involuted and entire. There are only three species of this genus, the principal of which is the pastinaca sativa, or garden parsnip, which is an exceedingly fine esculent root.

PASTORAL, in general, something that relates to shepherds; hence we say, pastoral life, manners, poetry, &c. The original of poetry is ascribed to that age which succeeded the creation of the world; and as the keeping of flocks seems to have been the first employment of mankind, the most ancient sort of poetry was probably pastoral.

PATENT, something that stands open or expanded: thus a leaf is said to be patent when it stands nearly at right angles with the stalk.

PATENT, or *Letters Patent*, are writings sealed with the great seal of England, by which a man is authorized to do, or to enjoy, any thing which of himself he could not. They are so called on account of their form, being open, with their seal affixed, ready to be exhibited for the confirmation of the authority delegated by them.

PATHOLOGY, that part of medicine which explains the symptoms of diseases.

PATROL, in war, a round or march made by the guards, or watch, in the night-time, to observe what passes in the streets, and to secure the peace and tranquillity of a city or camp. The patrol generally consists of a body of five or six men, detached from a body or guard, and commanded by a serjeant.

PATRON, both in the canon and common law, signifies him that hath the gift of a benefice or parsonage.

PATRONYMIC, among grammarians, is applied to such names of men and women as are derived from those of parents or ancestors.

PAUPER, *poor*, a name applied to a person receiving public charity.

PAVEMENT, a layer of stone, or other matter, serving to cover and strengthen the ground of divers places for the more commodious walking on. In London the pavement for coach-ways is chiefly a kind of granite from Scotland: and on the footpath Yorkshire paving is used; courts, stables, kitchens, halls, churches, &c. are paved usually with tiles, bricks, or fire-stones; and sometimes with a kind of free-stone and rag-stone. In France, the public roads, streets, courts, &c. are paved with gres, a kind of free stone. In Venice, the streets, &c. are paved with brick; churches sometimes with marble, and sometimes with Mosaic work. In Amsterdam, and the chief cities of Holland, they call their brick pavement the burgomaster's pavement, to distinguish it from the stone or flint pavement, which is usually in the middle of the street, serving for the passage of their horses, carts, coaches, and other carriages; the brick borders being designed for the passage of people on foot.

PAVO, the *peacock*, in ornithology, a genus belonging to the order of gallinæ. The head is covered with feathers which bend backwards; the feathers of the tail are very long, and beautifully variegated with eyes of different colours. Latham enumerates eight species. In this country, peacocks do not attain their full and brilliant plumage till their third year. The female lays five eggs, and is particularly solicitous to conceal them from the male, which not unfrequently destroys them. These birds feed almost solely on insects and grain. They prefer elevated situations for roosting, choosing the tops of houses and the highest trees for this purpose. They were considered as luxuries for the table by the Romans, and the young ones are now regarded as a delicacy. Their voice is harsh and dissonant, and in perfect contrast to that beauty exhibited by their plumage, which, in the language of Buffon, "seems to combine all that delights the eye in the soft and delicate tints of the finest flowers, all that dazzles in the sparkling lustre of the gem, and all that astonishes in the grand display of the rainbow."

PAUSE, a stop or cessation of speaking, singing, playing, or the like. The use of pointing, in grammar, is to make proper pauses in certain places. There is a pause in the middle of each verse; in an hemistich it is called a rest or repose.

PAUSUS, a genus of insects, of the order coleoptera. The generic character is: antennæ of two joints, the upper very large, inflated, moveable, and hooked; head stretched forwards; wing-sheaths flexile, deflected, truncated.

This rare insect is a native of Banana Island, and Sierra Leone in Africa. Its colour is a blackish brown.

PAWLE, in a ship, a small piece of iron bolted to one end of the beams of the deck, close to the capstan; but yet so easily, as that it can turn about. Its use is to stop the capstan from turning back.

PAWN, a pledge lodged for the security of the payment of a sum of money borrowed. As the party that pawns the goods has a general property therein, they cannot be forfeited by the person that has them in pawn, for any offence of his; neither can they be taken in execution for his debt. Where the pawn is redeemable on a certain day, it must be strictly observed, or upon failure of payment it may be sold.

PAY, in the sea language. The seamen say, pay more cable, when they mean to let out more cable.

PAYING, among seamen. When the seams of a ship are laid over with a coat of hot pitch, it is called paying her; and when this is done with canvas, parcelling; also when, after she is graved, and the soil burned off, a new coat of tallow and soap, or one of train oil, rosin, and brimstone boiled together, is put on her, that is also called paying of a ship.

PAYMENT, is the consideration or purchase-money for goods, and may be made by the buyer giving to the seller the price agreed upon, either by bill or note, or by money.

PEACE, in law, signifies a quiet and harmless behaviour towards the king and his people. The king, by his office and dignity royal, is the principal conservator of the peace within all his dominions, and may give authority to any other to see the peace kept, and to punish such as break it: hence it is usually called the king's peace.

PEACE, *justices of the*, are persons appointed by the king's commission to attend to the peace of the county where they dwell. They were called guardians of the peace till the 36th year of Edw. III. c. 12, where they are called justices.

A justice of the peace must, before he sits, take the oath of office, which is always done at the general quarter sessions for the county, by virtue of a dedimus potestatem out of chancery.

Sheriffs, coroners, attorneys, and proctors, may not act as justices of the peace.

The power, office, and duty of this magistrate, extends to an almost infinite number of instances, specified in some hundreds of acts of parliament, and every year accumulating.

PEACH, in botany. See Amygdalus.

PEACOCK. See Pavo.

PEARL. The pearl is a concretion found in several species of shells, as in some species of the oyster and the muscle. Pearls are of a silvery or blueish white colour, and very brilliant. They are formed of the same matter as the inner shell of the fish to which they belong, and consist of several coats spread with the greatest regularity over each other in a manner similar to those of an onion. The most important fishery to England at present is that of Ceylon. There are various methods of fishing for pearls in different parts of the world, but the Ceylon fishery is reckoned superior to them all.

Pearl, *mother of*, is the shell not of the pearl oyster, but of another sea-fish of the oyster kind. This shell on the inside is extremely smooth, and of the whiteness and water of pearl itself; and it has the same lustre on the outside, after the first laminæ or scales have been cleared off.

Pearls, *artificial*. As the genuine pearls are sold at an extravagant price, various methods have been contrived of imitating them so completely, that they can scarcely be distinguished from those collected in the East. The principal ingredient employed for this purpose consists of the fine silvery matter which is found on the lower side of the scales of the blay, or bleak fish *(Cyprinus alburnus)*. These scales are first removed; then washed repeatedly in pure water; and, after the different liquors have subsided, the fluid part is carefully decanted; when a pearly matter, of an oily consistence, remains at the bottom; which is denominated by the French, *Essence d'Orient*. A small portion of this matter is dropped in a hollow, bluish glass-bead, that is gently agitated, till the whole internal surface is completely lined; when the cavity is filled up with wax, in order to impart solidity and weight. Pearls thus manufactured, possess fewer blemishes than such as are natural or genuine, to which they are fully equal in point of brilliancy.

PEAT, a well-known inflammable substance, used in many parts of the world as fuel.

Peat is a congeries of vegetable matter, in which the remains of organization are more or less visible; consisting of the trunks of trees; of leaves, fruits, and stringy fibres, the remains of aquatic mosses. It occurs in extensive beds called peat mosses, occupying the surface of the soil, or covered to the depth of a few feet with sand, gravel, and other matters. It is met with in great abundance in the northern, and in some of the central districts of Europe: in moist, uncultivated, mountainous tracts, and likewise in low vallies and fenny plains; and in several parts of the western shore of Great Britain.

PEBBLES, the name of a genus of fossils, distinguished from the flints by having a variety of colours. These are defined to be stones composed of a crystalline matter debased by earths of various kinds in the same species: and then subject to veins, clouds, and other variegations, usually formed by incrustation round a central nucleus, but sometimes the effect of a simple concretion; and veined like the agates, by the disposition which the motion of the fluid they were formed in gave their differently-coloured substances.

PECK, a measure of capacity, four of which make a bushel.

PECORA, in natural history, the fifth order of the class mammalia. They have no foreteeth in the upper jaw, but several in the lower; feet hoofed, cloven: they live on herbs, chew the cud, and have four stomachs: viz. the paunch, to macerate and ruminate the food; the bonnet, reticulate, to receive it; the omasus, of numerous folds, to digest it; and the abomasus, to give it acescency, and prevent putrefaction. There are eight genera, viz.

Antelope
Bos
Camelus
Camelopardalis
Capra
Cervus
Moschus
Ovis.

PECTEN, the *scallop;* a genus of shell-fish, the characters of which are these: the animal is a tethys; the shell bivalve and unequal; the hinge toothless, having a small ovated hollow.

PEDESTAL. See ARCHITECTURE.

PEDICELLARIA, a genus of insects, of the order vermes mollusca: the generic character is, body soft and seated on a rigid peduncle; aperture single. There are three species.

PEDICULARIS, *red-rattle, or louse-wort*, a genus of the didynamia angiospermia glass of plants, the corolla whereof consists of a single ringent petal; the tube is oblong and gibbous: the upper lip galeated, erect, compressed, and emarginated; the under one is patent, plane, semitrifid, and obtuse; the fruit is a roundish acuminated capsule; the seeds are numerous, roundish, compressed, and covered. There are 19 species.

PEDICULUS, louse, a genus of insects of the order aptera: the generic character is, legs six, formed for walking; mouth furnished with an exsertile piercer; antennæ the length of the thorax; abdomen depressed, sublobated. Few insects are more prolific than the louse. It is said, that in about eight weeks a louse might see five thousand of its own descendants.

PEDIMENT, in architecture, is a kind of low pinnacle, serving to crown an ordonnance, or finish a frontispiece, and is placed as an ornament over gates, doors, windows, niches, altars, &c. being ordinarily of a triangular form, but sometimes forming an arch of a circle.

PEDOMETER. See PERAMBULATOR.

PEEK, in the sea language, is a word used in various senses. Thus the anchor is said to be a peek, when the ship being about to weigh, comes over her anchor in such a manner that the cable hangs perpendicularly between the hawse and the anchor. To heave a peek, is to bring the peek so that the anchor may hang a peek. A ship is said to ride a peek. when lying with her main and fore-yards hoisted up, one end of her yards is brought down to the shrouds, and the other raised up on end; which is chiefly done when she lies in rivers, lest other ships falling foul of the yards should break them.

PEER, in general, signifies an equal, or one of the same rank and station: hence, in the acts of some councils, we find these words, with the consent of our peers, bishops, abbots, &c. Afterwards the same term was applied to the vassals or tenants of the same lord, who were called peers, because they were all equal in condition, and obliged to serve and attend him in his courts: and peers in *fief*, because they all held fiefs from the same lord.

The term peers is now applied in our common law to those who are impannelled in an inquest upon any man, for the convicting or clearing him of any offence, for which he is called in question; and the reason is, because the course and custom of our nation is, to try every man in such a case by his equals, or peers.

PEERS *of the realm*, are the nobility of the kingdom, and lords of parliament; who are divided into dukes, marquises, earls, viscounts, and barons and the reason why they are called peers is, because, notwithstanding there is a distinction of dignities in our nobility, yet in all public actions they are equal, as in their votes of parliament, and in passing upon the trial of any nobleman.

PEERESS, a woman who is noble by descent, creation, or marriage. If a peeress, by descent or creation, marries a person under the degree of nobility, she still continues noble; but if she obtains that dignity only by marriage, she loses it on her afterwards marrying a commoner; yet, by the courtesy of England, she always retains the title of her nobility.

PEGASUS, in astronomy, a northern constellation, containing, according to the latest observations, about fifty-six stars.

PEGASUS is also a genus of fishes of the order nantes: the generic character is, snout elongated. mouth beneath; pectoral fins large, ventral single-rayed; body depressed, mailed, with the abdomen divided into bony segments

PELAGIANS, a Christian sect who appeared before the latter part of the fourth, or the beginning of the fifth century. Pelagius, the author of this sect, was born in Wales, and his name was Morgan, which in the Welsh language signifies sea-born; whence he had his Latin name Pelagius. He was charged with maintaining the following doctrines: 1. That Adam was by nature mortal, and whether he had sinned or not, would certainly have died 2. That the consequences of Adam's sin were confined to his own person. 3. That new-born infants are in the same condition with Adam before the fall. 4. That the law qualified men for the kingdom of heaven, and was founded upon equal promises with the gospel. 5. That the general resurrection of the dead does not follow in virtue of our Saviour's resurrection. 6. That the grace of God is given according to our merits. 7. That this grace is not granted for the performance of every moral act; the liberty of the will, and information in points of duty, being sufficient. &c.

PELICANUS, in ornithology, a genus belonging to the order of anseres. The bill is straight, without teeth, and crooked at the point; the face is naked; and the feet are palmated. Mr. Latham enumerates no less than 30 different species of this genus, beside varieties. The most remarkable seem to be these that follow.

P. onocrotalus, or the great pelican, is sometimes of the weight of twenty-five pounds, and of the width, between the extreme points of the wings, of fifteen feet; the skin, between the sides of the upper mandible, is extremely dilatable. reaching more than half a foot down the neck, and capable of containing many quarts of water. This skin is often used by sailors for tobacco-pouches, and has been occasionally converted into elegant ladies' work-bags. About the Caspian and Black Seas, these birds are very numerous, and they are chiefly to be found in the warmer regions, inhabiting almost every country of Africa.

P. aquilus, or the man-of-war bird, is small in body, but between the extremities of the wings fourteen feet in width. It is seldom seen but within the tropics, and not unfrequently is observed 200 leagues from land. It watches the movements of fishes from a very considerable height, and pounces upon them with unfailing success, returning from its immersion with

equal rapidity. It also often obliges other birds to quit the prey which they have just made, and are flying off with, and seizes it as it drops from them with a dexterity truly admirable.

1. The *carbo,* or cormorant, sometimes exceeds seven pounds in weight; the length three feet four; the extent four feet two; the bill dusky, five inches long, destitute of nostrils; the base of the lower mandible is covered with a naked yellow skin, that extends under the chin, and forms a sort of pouch; a loose skin of the same colour reaches from the upper mandible round the eyes and angles of the mouth; the head and neck are of a sooty blackness, but under the chin of the male the feathers are white; and the head in that sex is adorned with a short, loose, pendant crest; in some the crest and hind part of the head are streaked with white.

The birds occupy the highest parts of the cliffs that impend over the sea: they make their nest of sticks, sea-tang, grass, &c. and lay six or seven white eggs of an oblong form. In winter they disperse along the shores, and visit the fresh waters, where they make great havoc among the fish. The cormorant has the rankest and most disagreeable smell of any bird, even when alive. Its form is disagreeable, its voice hoarse and croaking, and its qualities base. These birds, however, have been trained to fish, as falcons to fowl. Whitelock tells us, that he had a cast of them manned like hawks, and which would come to hand. He took much pleasure in them; and relates, that the best he had was one presented him by Mr. Wood, master of the cormorants to Charles I.

The *bassanus,* gannet, or solan goose, weighs seven pounds; the length is three feet one inch; the breadth six feet two inches. The bill is six inches long, straight almost to the point where it inclines down; and the sides are irregularly jagged, that it may hold its prey with more security; it has no nostrils, but in their place a long furrow, that reaches almost to the end of the bill; the whole is of a dirty white, tinged with ash-colour. These birds frequent the isle of Alisa, in the frith of Clyde; the rocks adjacent to St. Kilda; the Stalks of Souliskerry, near the Orkneys; the Skelig Isles off the coasts of Kerry, Ireland; and the Bass Isle in the frith of Forth; the multitudes that inhabit these islands are prodigious.

PELLICLE, among physicians, &c. denotes a thin film, or fragment of a membrane.

PELVIS, in anatomy, the lower part of the cavity of the abdomen; thus called from its resemblance to a bason, in Latin called pelvis

PEN, *fountain,* is a pen made of silver, brass, &c. contrived to contain a considerable quantity of ink, and let it flow out by gentle degrees, so as to supply the writer a long time without being under the necessity of taking fresh ink.

PENALTY, is a forfeiture inflicted for not complying with the regulations of certain acts of parliament; a penalty is also annexed to secure the performance of certain covenants in a deed, articles of agreement, copartnership, &c. In a bond also for payment of money, it is usual to annex a penalty in double the amount of the obligation.

PENCIL, an instrument used by painters for laying on their colours. Pencils are of various kinds, and made of various materials, the larger sorts are made of boars' bristles, the thick ends of which are bound to a stick, bigger or less according to the uses they are designed for; these, when large, are called brushes. The finer sorts of pencils are made of camels, badgers, and squirrels' hair, and of the down of swans; these are tied at the upper end with a piece of strong thread, and inclosed in the barrel of a quill. All good pencils on being drawn between the lips come to a fine point.

Pencil is also an instrument used in drawing, writing, &c. made of long pieces of black-lead, or red chalk, placed in a groove cut in a slip of cedar, on which other pieces of cedar being glued, the whole is planed round, and one of the ends being cut to a point, it is fit for use.

PENDULUM, in mechanics, denotes a heavy body so suspended that it may vibrate, or swing backwards and forwards about a fixed point by the action of gravity.

The vibrations of a pendulum are called its oscillations. A pendulum, therefore, is any body, B, Plate XLII. fig. 1, suspended upon, and moving about a fixed point, A, as a centre. The nature of a pendulum consists in the following particulars: 1. The times of the vibrations of a pendulum, in very small arches, are all equal. 2. The velocity of the bob, in the lowest point, will be nearly as the length of the chord of the arch which it describes in the descent. 3. The times of vibration in different pendulums, A B, A C, are as the square roots of the times of their vibrations. 4. The time of one vibration is to the time of the descent, through half the length of the pendulum, as the circumference of a circle to its diameter. 5. Whence the length of a pendulum, vibrating seconds, will be found 39.2 inches nearly; and that of an half second pendulum 9.8 inches. 6. An uniform homogeneous body B G, fig. 2, has a rod, staff, &c. which is one third part longer than a pendulum A D, will vibrate in the same time with it. See fig. 3.

From these properties of the pendulum we may discern its use as an universal chronometer, or regulator of time, as it is used in clocks, and such-like machines.

By this instrument also we can measure the distance of a ship, by measuring the interval of time between the fire and the sound of the gun. also the distance of a cloud, by numbering the seconds, or half-seconds, between the lightning and thunder; thus, suppose between the lightning and thunder, we number 10 seconds; then, because sound passes through 1142 feet in one second, we have the distance of the cloud equal to 11.420 feet. Again, the height of any room, or other object, may be measured by a pendulum vibrating from the top thereof. Thus, suppose a pendulum from the height of a room vibrates once in three seconds; then say, as 1 is to the square of 3, viz. 9, so is 39.2 to 352.8 feet, the height required. Lastly, by the pendulum we discover the different force of gravity on different parts of the earth's surface, and thence the true figure of the earth.

The following is a brief description of what is commonly termed the *gridiron* pendulum.—Instead of one rod, this pendulum is composed of any convenient odd number of rods, as five, seven, or nine: being so connected, that the effect of one set of them counteracts that of the

other set; and therefore, if they are properly adjusted to each other, the centres of suspension and oscillation will always be equidistant.

Fig. 4. represents a gridiron pendulum composed of nine rods, steel and brass alternately. The two outer rods, A B, C D, which are of steel, are fastened to the cross pieces A C, B D by means of pins. The next two rods, E F, G H, are of brass, and are fastened to the lower bar BD, and to the second upper bar E G. The two following rods are of steel, and are fastened to the cross bars E G and I K. The two rods adjacent to the central rod being of brass, are fastened to the cross pieces I K and L M; and the central rod to which the ball of the pendulum is attached, is suspended from the cross piece L M, and passes freely through a perforation in each of the cross bars I K, B D. From this disposition of the rods, it is evident that, by the expansion of the extreme rods, the cross piece B D, and the two rods attached to it, will descend: but since these rods are expanded by the same heat, the cross piece E G will consequently be raised, and therefore also the two next rods; but because these rods are also expanded, the cross bar I H will descend: and by the expansion of the two next rods, the piece L M will be raised a quantity sufficient to counteract the expansion of the central rod. Whence it is obvious, that the effect of the steel rods is to increase the length of the pendulum in hot weather, and to diminish it in cold weather, and that the brass rods have a contrary effect upon the pendulum. The effect of the brass rods must, however, be equivalent not only to that of the steel rods, but also to the part above the frame and spring, which connects it with the cock, and to that part between the lower part of the frame and the centre of the ball.

The gridiron pendulum was the invention of Mr. John Harrison, a very ingenious artist, and celebrated for his invention of the watch for finding the difference of longitude at sea, about the year 1725, and of several other time-keepers and watches since that time; for all which he received the parliamentary reward of between £20,000 and £30,000.

Pendulum, *royal*, a name used among us for a clock, whose pendulum swings seconds, and goes eight days without winding up; shewing the hour, minute, and second. The numbers in such a piece are thus calculated: First cast up the seconds in twelve hours, which are the beats in one turn of the great wheel: and they will be found to be $43200 = 12 \times 60 \times 60$. The swing-wheel must be 30, to swing 60 seconds in one of its revolutions; now let the half of 43200, viz. 21600, be divided by 30, and the quotient will be 720, which must be separated into quotients. The first of these must be 12. for the great wheel, which moves round once in 12 hours. Now 720 divided by 12, gives 60; which may also be conveniently broken into two quotients, as 10 and 6, or 12 and 5, or 8 and $7\frac{1}{2}$, which last is most convenient; and if the pinions are all taken 8, the work will stand thus:

$$\begin{array}{rrl} 8\,) & 96 & (\ 12 \\ 8\,) & 64 & (\ 8 \\ 8\,) & 60 & (\ 7\frac{1}{2} \\ \hline & & \ \ 30 \end{array}$$

According to this computation, the great wheel will go round once in 12 hours, to shew the hour; the next wheel once in an hour, to shew the minutes: and the swingwheel once in a minute, to shew the seconds.

PENELOPE, a genus of birds of the order of gallinæ; the characters of which are: the beak is bare at the base; the head is covered with feathers; the neck is quite bare; the tail consists of twelve principal feathers; and the feet are for the most part bare.

PENGUIN. See **Alca.**

PENNATULA, or **Sea-pen**, a genus of zoophyte, which, though it swims about freely in the sea, approaches near to the gorgonia. This genus has a bone along the middle of the inside, which is its chief support; and this bone receives the supply of its osseous matter by the same polype-mouths that furnish it with nourishment. Linnæus reckons seven species.

PENNY, formerly a silver, but now a copper coin.

The penny was the first silver coin struck in England by our Saxon ancestors, being the 240th part of their pound, and its true weight was about 22½ grains troy.

Penny-weight, a troy weight, being the 20th part of an ounce, containing 24 grains; each grain weighing a grain of wheat gathered out of the middle of the ear, well dried.

PENTAGON, in geometry, a figure having five sides, and five angles.

PENTAGRAPH, or **Parallelogram**, an instrument whereby designs of any kind may be copied in any proportion, without the operator being skilled in drawing.

The common pentagraph, however, it must be acknowledged, is an exceedingly imperfect instrument in practice, so much so that artists seldom make any use of it. There have been some improvements on it of late, and one in particular by Harris of London; but in this the work is complex, and the price necessarily high. This latter, instead of being fastened to the table when in use, is delicately suspended in an elevated frame, by which means the artist can regulate the pressure of the point employed in tracing with the utmost exactness.

An instrument for copying with great correctness, simple in its construction, and at a moderate price, is still a desideratum; and perhaps the nearest approach to this yet made, i late invention of Professor Wallace of the university of Edinburgh, and to which he has given the name of *Eidograph*, or *form copier*, a description of which may be seen in the Supplement to the Encyclopædia Britannica, and in the Glasgow Mechanics' Magazine, vol. i. p. 242.

PENTAMETER, in ancient poetry, a kind of verse consisting of five feet, or metres, whence the name.

PENTANDRIA, in botany, one of Linnæus's class of plants, the fifth in order; the characters of which are, that all the plants comprehended in it have hermaphrodite flowers, with five stamina or male parts in each; they are subdivided into orders, which are denominated monogynia, digynia, trigynia, &c. according as there are one, two, three, &c. pistils, or female parts, in each flower.

PENTAPETES, a genus of the dodecandria order, in the monadelphia class of plants, and in the natural method ranking under the 37th

order, columniferæ. There is but one species known in the gardens of this country, viz. the phœnicia, with halbert-pointed, spear-shaped, sawed leaves. It is an annual plant, a native of India.

PENTHORUM, a genus of the pentagynia order, in the pentandria class of plants. The calyx is quinquefied; there are either five petals or none; the capsule is five-pointed and quinquelocular. There is one species.

PENTSLEMON, a genus of the didynamia angiospermia class and order. The calyx is five leaved; the corolla bilabiate, ventricose; rudiment of a 5th stamen, bearded above; capsules two-celled. There are two species.

PENUMBRA, in astronomy, a partial shade observed between the perfect shadow and the full light in an eclipse.

PEPLIS, a genus of the monogynia order, in the hexandria class of plants, and in the natural method ranking under the 17th order calycanthemæ. The perianthium is campanulated; the mouth cleft in twelve parts; there are six petals inserted into the calyx; the capsule is bilocular. There are two species, creeping plants.

PEPPER. See Piper.

PERAMBULATOR, in surveying, an instrument for measuring distances, called also pedometer, way-wiser, and surveying wheel.

Plate XLI, AA, fig. 5, is a wheel of mahogany, tired with iron, and made very strong; its circumference must be exactly ninety-nine inches, or half a pole. This is placed so as to turn round in an opening cut in the piece BD, which forms the frame. In the arm B, a groove is cut from the centre of the wheel to the dial *b*; the end of the spindle comes through the wood into this groove, and has a small crown-wheel of eight teeth upon it. This works another wheel of eight teeth fixed on a long spindle, which conveys motion from the wheel beneath to the dial *b*. The groove containing this spindle has a slip of wood screwed over it, to keep out dirt, &c.; and the end of this spindle has a square hole in it, into which is put the square end of the spindle *a*, fig. 6. This has an endless screw *d* upon it, which works a worm wheel *e* of twenty four teeth, having a pinion of twelve beneath it; and below this has a wheel *f* of thirty-six. The pinion works the wheel *g* of forty: and the wheel *f* turns the pinion *h* of twelve, whose spindle carries the short hand of the dial, fig. 7. The arbour of the wheel *g* comes up through the dial, and has the hand F on it; as also a pinion of eight, which turns *g* of sixty-four. In the arbour of the wheel *h*, is a pinion *i* of six, taking into *k* of seventy-two; this is here supposed to be half broken away, to shew the wheels beneath. The spindle of this is hollow, and is put over the arbour of the wheel *g*; and carries the hand G. HHHH are four pillars, by which the two plates forming the frame for the wheels are held together. The wheel *g* is not fixed fast to its spindle, but is held between a brass plate *l* and another beneath; the friction of these causes the wheel to turn the hand, and at the same time leaves the hand at liberty to be set without moving the wheels. The plate *l* has a pin *n* fixed in it; which pin takes against a projecting part of the handle of the hammer *m*, so as to lift it up when the plate is turned, and let the spring *o* through *w* against the bell K.

When any distance is to be measured by this machine, the operator takes hold of the handle, and wheels it along in as straight a line as he can. The circumference of the wheel being ninety-nine inches (or half a pole), and the two wheels in the piece being equal, the screw *d* will turn once in each turn of the great wheel, or twice for every pole the machine is wheeled. This screw must be so cut that the great wheel must turn twenty-four times for one turn of the wheel *e*, and also the wheel *f* on the same spindle as this must turn a pinion *h* of one-third of its number of teeth. The short hand on the dial which it carries will for every revolution require eight turns of the great wheel, = four poles, = one chain. The circle is divided into 100 parts, each = one link. The pinion of twelve on the arbour of the wheel *e*, turning once for twenty-four turns of the great wheel, makes the wheel *g* require for each revolution eighty turns of the great wheel, or for the machine to be wheeled ten chains (or turns of the short hand) = 40 poles (as the circle of its hand is divided), = one furlong: and at each revolution of this wheel, the hammer *m* will strike the bell K. The pinion of eight on the arbor of the wheel *g*, works *h* of sixty-four; and its pinion *i* turns K of seventy-two; the result of which will be, that the hand on the spindle of *k* will require for each revolution 7680 turns of the great wheel, or for the machine to be wheeled 3840 poles, = 960 chains or turns of the short hand, = 96 furlongs or turns of the hand F and strokes on the bell, = twelve miles as the dial is divided.

PERCA, Perch, a genus of fishes of the order thoracici; the generic character is, teeth sharp, incurvate; gill-covers triphyllous, scaly, serrated; dorsal fin spiny on the fore part; scales (in most species) hard and rough.

PERCUSSION, in mechanics, the impression a body makes in falling or striking upon another, or the shock of two bodies in motion. See Motion.

Percussion is either direct or oblique; direct, when the impulse is given in a line perpendicular to the point of contact; and oblique, when it is given in a line oblique to the point of contact.

PERENNIAL, in botany, is applied to those plants whose roots will abide many years, whether they retain their leaves in winter or not; those which retain their leaves are called evergreens; but such as cast their leaves, are called deciduous.

PERGALESIA, a genus of the pentandria digynia class and order. Contorted nect. surrounding the genitals with five-sagittated cups; corolla salver-shaped. There are five species, twining plants of the Cape, &c.

PERIANTHIUM. See Botany.

PERICARDIUM. See Anatomy.

PERICARPIUM, among botanists, a covering or case for the seeds of plants. See Botany.

PERICRANIUM. See Anatomy.

PERIGÆUM, perigee. See Astronomy

PERIHELIUM. See Astronomy.

PERILLA, a genus of the class and order didynamia gymnospermia. The calyx uppermost; segment very short; stamina distant styles two, connected. There is one species an annual of the East Indies.

PERIMETER, in geometry, the bounds of

limits of any figure or body. The perimeters of surfaces or figures are lines, those of bodies are surfaces. In circular figures, instead of perimeter, we say circumference, or periphery.

PERINÆUM, or **Perineum**. See Anatomy.

PERIOD, in astronomy, the time taken up by a star or planet in making a revolution round the sun; or the duration of its course till it returns to the same point of its orbit. See Astronomy.

Period. See Chronology.

Period, in grammar, denotes a small compass of discourse, containing a perfect sentence, and distinguished at the end by a point, or full stop, thus (.): and its members or divisions marked by commas, colons, &c.

PERIŒCI. See Geography.

PERIOSTEUM. See Anatomy.

PERIPHERY, in geometry, the circumference of a circle, ellipsis, or any other regular curvilinear figure. See Circle, &c.

PERJURY, is a crime committed when a lawful oath is administered, by any one who has authority, to a person in any judicial proceeding, who swears wilfully, absolutely, and falsely, in a matter material to the issue or cause in question, by his own act, or by the subornation of others. To constitute perjury, it is essential that the oath is wilfully taken; that it is in a judicial proceeding, or some other public proceeding of a similar nature: the oath must be taken before persons lawfully authorized to administer it, and also by a person sworn to depose the truth; it must also be taken absolutely and directly, and upon something material, to the point in issue.

PERIWINKLE. See Turbo.

PERMIT, a licence or warrant for persons to pass with or sell goods, having paid the duties of customs and excise.

PERMUTATION *of quantities*, in algebra, the same with combination. See Combination.

PERORATION, in rhetoric, the epilogue, or last part of an oration, wherein what the orator had insisted on through his whole discourse, is urged afresh with greater vehemence and passion. The peroration consists of two parts: 1. Recapitulation, wherein the substance of what was diffused throughout the whole speech is collected briefly, and cursorily, and summed up with new force and weight. 2. The moving the passions, which is so peculiar to the peroration, that the masters of the art call this part *sedes affectuum*.

PEROXIDE, in chemistry, signifies the maximum of oxidizement. See Oxide.

PERPENDICULAR. See Geometry.

PERPETUITY, in annuities, the number of years' purchase to be given for an annuity which is to continue for ever. It is found by dividing 100*l.* by the rate of interest.

PERRY, a drink made of pears in the same manner as cyder is made from apples. See Cyder.

PERSECUTION, is any pain or affliction which a person designedly inflicts upon another; and, in a more restrained sense, the sufferings of Christians on account of their religion. Historians usually reckon ten general persecutions, the first of which was under the emperor Nero, thirty-one years after our Lord's ascension; when that emperor having set fire to the city of Rome, threw the odium of that execrable action on the Christians, who under that pretence were wrapped up in the skins of wild beasts, and worried and devoured by dogs; others were crucified, and others burnt alive. The second was under Domitian, in the year 95. In this persecution St. John the apostle was sent to the isle of Patmos, in order to be employed in digging in the mines. The third began in the third year of Trajan, in the year 100, and was carried on with great violence for several years. The fourth was under Antoninus the philosopher, when the Christians were banished from their houses, forbidden to shew their heads, reproached, beaten, hurried from place to place, plundered, imprisoned, and stoned. The fifth began in the year 197, under the Emperor Severus. The sixth began with the reign of the Emperor Maximinus in 235. The seventh, which was the most dreadful persecution that had ever been known in the church, began in the year 250, in the reign of the emperor Decius, when the Christians were in all places driven from their habitations, stripped of their estates, tormented with racks, &c. The eighth began in the year 257, in the fourth year of the reign of the emperor Valerian. The ninth was under the emperor Aurelian, A. D. 274, but this was very inconsiderable; and the tenth began in the nineteenth year of Dioclesian, A.D. 303. In this dreadful persecution, which lasted ten years, houses filled with Christians were set on fire, and whole droves were tied together with ropes, and thrown into the sea.

PERSIAN *wheel*, an engine, or wheel, turned by a rivulet, or other stream of water, and fitted with open boxes at its cogs, to raise water for the overflowing of lands, or other purposes.

PERSON, in grammar, a term applied to such nouns or pronouns, as being either prefixed or understood, are the nominatives in all inflections of a verb: or it is the agent or patient in all finite and personal verbs.

PERSONAL GOODS. See Chattels.

PERSONATE, is the representing a person by a fictitious or assumed character, so as to pass for the person represented. Personating bail, is by stat. 21 Jac. I, c. 26, a capital felony. By various other statutes, personating seamen entitled to wages, prize-money, &c. is also a capital felony.

PERSPECTVE, is the art of drawing on a plane surface, in outline, the resemblance of any object, as that object itself would appear to the eye from any distance and situation, real or imaginary. In the following short article on the subject we can only lay down a few general principles for the assistance of the young student, who will do well to consult the excellent treatises of Brook, Taylor, Nicholson, Ferguson, and the short, but superior, practical treatise on perspective by Mr. J. Varley, of London.

The student is supposed to be tolerably well acquainted with geometry, without the knowledge of which his progress and success in the practical part of perspective must be slow, and attended with great uncertainty. Before proceeding to the practical part of this science, it may be of importance to explain some of the technical terms used by artists in regard to it. And first, the horizontal line is that supposed to be drawn parallel to the horizon through the eye of the spectator; or rather it is a line which separates the heaven from the earth, and which

limits the sight. Thus, A, B, fig. 1, Plate XLIII, are two pillars below the horizontal line CD, by reason the eye is elevated above them; in fig. 2, they are said to be equal with it; and in fig. 3, raised above it. Thus, according to the different points in view, the objects will be either higher or lower than the horizontal line. The point of sight, A, fig. 4, is that which makes the central ray on the horizontal line; or, it is the point where all the other visual rays, D, D, unite. The points of distance, C, C, are points set off in the horizontal line at equal distances on each side of the point of sight, A; and, in the same figure, BB represents the base line, or fundamental line; EE is the abridgement of the square, of which D, D, are the sides; F, F, the diagonal lines, which go to the points of distance C, C. Accidental points, are those where the objects end: these may be cast negligently, because neither drawn to the point of sight, nor to those of distance, but meeting each other in the horizontal line. The point of direct view, or of the front, is when we have the object directly before us; in which case, it shews only the foreside; and, if below the horizon, a little of the top, but nothing of the sides, unless the object is polygonous. The point of oblique view, is when we see an object aside of us, and, as it were, aslant, or with the corner of the eye; the eye, however, being all the while opposite to the point of sight: in which case, we see the object laterally, and it presents to us two sides or faces. The practice is the same in the side-points, as in the front points; a point of sight, points of distance, &c. being laid down in the one as well as in the other.

Parallel perspective is where the picture is supposed to be so situated, as to be parallel to the side of the principal object in the picture, as a building for instance.

Oblique perspective, is when the plane of the picture is supposed to stand oblique to the sides of the objects represented, in which case the representations of the lines upon those sides will not be parallel among themselves, but will tend towards their vanishing point.

A bird's-eye view, is a view supposed to be taken in the air, looking down upon the object, and differs from the usual way of drawing perspective views, in supposing the horizontal line to be raised much higher.

When an object is to be drawn in perspective, all its parts must be measured, so that we may be able to lay them down from a scale of equal parts.

Having determined whether it is to be parallel or oblique perspective, the first thing to be drawn is the horizontal line, which is to be put parallel to the bottom of the drawing, and as high above it as the height of a man's head, or five feet six inches, as HG, fig. 5, which is five feet six inches above the bottom of the house. Next, determine on the centre of the picture G, which must be placed so as to leave convenient room for the representation. Fix on C the nearest corner of the object, and draw the perpendicular CB: lay off CD equal to the length of the building, and draw DA and AB. From C, the nearest corner, draw CG to the centre of the picture. CG now contains the line which represents the bottom of the end of the house; but this is an indefinite representation, of which we do not yet know the exact length. The method of determining this is as follows: Continue the line DC to I, and make CI equal to the width of the house. From G, the centre of the picture, lay off G K equal to the distance of the picture, the choosing of which must be regulated by taste. Draw IK, cutting CG in F; then is CF the exact width of the house in perspective, which was equal to CI. To find the middle of this end of the house, you cannot divide it by your compasses, because the farthest half will appear less than the nearer; but if you divide CI into two equal parts in L, and draw LK, it will cut CF into two equal parts perspectively. Or it may be found more simply thus: having drawn the lines BE and CF to the centre of the picture, draw the diagonals EC, BF, crossing each other in M, and raise the perpendicular MN, which is in the middle of the gable end.

To find the height of the gable, lay its actual height above BE, upon the corner line BC continued, as BO, and draw OG; this crossing the perpendicular MN, gives N the point of the gable. The top of the chimney must be drawn in the *same* manner, by laying its *real* height, taken from a scale, on OP; and drawing PG, lay off L*m* and L*n*, each equal to half the width, and draw from these points to the distance-point K; this will cut the bottom of the house CF, in the points *a* and *p*; from these draw perpendiculars, which will give the perspective width of the chimney. To obtain its thickness, lay off PQ equal to its thickness, and draw QG; then drawing from *a* the line *ab*, you obtain the exact width of the chimney. From *b* draw *bc*, and from *d* draw *dc*. The other end of the gable may be drawn by two different methods. The first is by supposing the front of the house transparent, and drawing the other end as if seen through it, in the same manner as the end we have described, by laying its width from D to R, and drawing to the distance-point K. By raising the perpendicular in the middle, you will meet the ridge-line from the other gable in *d*. The other method is as follows: through the centre of the picture G draw the line ST, upwards and downwards, and perpendicular to the horizontal line. Then continue the line of the roof B*d* till it meets ST in S. From A draw AS, which will give the other gable, and S will be the vanishing-point for all lines parallel to B*d* and A*d*; if NE is continued in like manner, it will give T for its vanishing-point. The doors and windows on the side ABCD are laid down from a scale, because that side being parallel to the picture, does not vary from its geometrical delineation, except shewing the thickness of the reveals, or edges of the doors and windows. If there had been any windows in the side BEFC, they would be drawn in perspective by the same method that was used for finding the width of the house and the middle of the end, viz. by laying off the actual dimensions from C upon CI, and drawing from these points to the distance-point K, which would transfer these divisions to the bottom of the house CF, and then perpendiculars might be drawn upwards.

PROBLEM I.

To divide a line in perspective which is parallel to the horizon, and which tends to a vanishing-point, into any number of equal parts; or to divide it into any required proportion

Let A B be the li [illegible] ishing point C, fig 6; and first let it be required to divide that line into six equal parts. Let C D be the horizontal line, and A E the ground line, drawn parallel to it. Lay off at pleasure, C D for the distance of the picture, if C is the centre of the picture. Draw a line from D, touching the end B of the line to be divided: draw D B E, cutting the ground-line in E. Then A E represents the actual dimensions of the line A B, which is seen in perspective. Here it may be observed, that this gives a rule also for finding the real length of any line which tends to a vanishing point. Divide A E into the same number of equal parts into which you proposed to divide the given line A B; as A 1 1 2, 2 3, &c. Then from these different divisions draw lines to D, cutting the line A B in *a*, *b*, *c*, *d*, &c. which will represent the required number of equal parts, but diminishing in size as they are farther removed from the eye. If it is wished to divide the line A B into any number of unequal parts, or to lay off doors, windows, &c. upon it, the line A E, found as before, must be divided into the required proportion, and lines drawn from those to D will give the required divisions on A B, from which perpendiculars may be drawn for the doors, windows, &c.

Problem 2.

To draw a circle in perspective.

The perspective representation of every circle is an ellipsis, when the eye is without the circle. This is obvious, because the rays from the circumference of the circle to the eye form an *oblique cone*. But those who are acquainted with conic sections, know that every section of a cone, whether right or oblique, is a true ellipsis, except when the section is taken subcontrary to its base, a situation which happens so rarely in drawings as to be altogether disregarded, and the section of a cone, or the perspective of a circle, is in all cases considered a perfect ellipsis.

The most correct and easy method of drawing an ellipsis is, to find the transverse and conjugate axes; the curve is then completed by a trammel, or the hand. But as it is difficult to find the transverse and conjugate axes of the ellipsis, which are the perspective, if the circle to be put in perspective be small, describe a square about it. Draw first the diagonals of the square fig. 7, and then the diameters *h a* and *d e*, cutting one another at right angles; draw the straight lines *f g* and *b c* parallel to the diameter *d e*. Through *b* and *f*, and *c* and *g*, draw straight lines meeting D E, the ground of the picture in the points 3 and 4. To the principal V draw the straight lines I V, 3 V, 4 V, 2 V, and to the points of distance L and K, 2 L and 1 K. Lastly, join the points of intersection *a*, *b*, *d*, *f*, *h*, *g*, *e*, *c*, by the arcs *a b*, *e d*, *d f*, and *a b d f h g e c a* will be the circle in perspective. In this process, it is of consequence to know that the curve you trace is a regular ellipsis: for though you cannot easily ascertain the axes *exactly*, yet you may *very nearly*; and the eye soon discovers whether the curve drawn be that of a regular ellipsis.

Problem 3.

To represent a double cross in perspective.

In fig. 8, let A B C D and E F G H be two [illegible] ve squares, [illegible] nd parallel to one another, the uppermost directly above the lowermost, drawn by the rules already laid down, and as far asunder as is equal to the given height of the upright part of the cross; S being the point of sight, and P the point of distance, in the horizon P S taken parallel to A D.

Draw A E, D H, and C G; then A E H D and D H G C shall be the two visible sides of the upright part of the cross; of which, the length A E is here made equal to three times the breadth E H.

Divide D H into three equal parts, H I, I K, and K D. Through these points of division, at I and K, draw M O and P R parallel to A D: and make the parts M N, I O, P Q, K R, each equal to H I: then draw M P, and O R parallel to D H.

From M and O, draw M S and O S to the point of sight S; and from the point of distance P draw P N, cutting M S in T: from T draw T U parallel to M O, and meeting O S in U and you will have the uppermost surface M T U of one of the cross pieces of the figure.—From R, draw R S to the point of sight E; and from U draw U V parallel to O R; and O U V R shall be the perspective square end next the eye of that cross part.

Draw P M *x* (as long as you please) from the point of distance P, through the corner M; lay a ruler to N and S, and draw X N from the line P *x*:—then lay the ruler to I and S, and draw Y Z S.—Draw X Y parallel to M O, and make X W and Y B equal and perpendicular to X Y: then draw W B parallel to X Y, and W X Y B shall be the square visible end of the other cross part of the figure.

Draw B K toward the point of sight S; and from U draw V P to the point of distance P, intersecting Y S in Z: then, from the intersection Z draw Z *a* parallel to M O, and Z *b* parallel to H D, and the whole delineation will be finished.

This done, shade the whole, as in fig. 9, and you will have a true perspective representation of a double cross.

Fig 10 shows the method of drawing a building, or other object, in oblique perspective. A B is the horizontal line, and C D the ground line, parallel to it as before. Here neither of the sides of the house is parallel to the picture; but each goes to its respective vanishing-point. Having fixed on the nearest corner E, draw E B, at pleasure, for one side, and choose any point F for the centre of the picture; then, to find the other side, lay off F G equal to the distance of the picture, which as before depends upon taste only; draw B G, and G A perpendicular to B G cutting the horizontal line in A, the other vanishing point. Draw now E A for the other side. To cut off the several widths of the two sides of the house, which as yet are only drawn to an indefinite extent, two distance points must be laid down, viz. one for each vanishing-point. To do this, extend the compasses from B to G, and lay the distance taken in it from B to H which will give H for the distance-point of B, and which is to cut off all the divisions on the side E B. Also extend the compasses from A G, and lay down A I. I is the distance point of A, and is used for transferring all divisions upon the side E A from the ground-line G E. These points and lines being adjusted, the process is not much different from parallel

perspective; only here equal divisions on each side of the building, as doors, windows, diminish as they recede, in the same way as on the side BEFC, fig. 10. Lay the real length of the side EL, taken from the same scale used for laying down the horizontal line, and lay it down on the ground-line, from E to C, and draw CI, cutting off EL for the perspective length of the building. For the other side of the house, lay its width down in the same manner, from E to D, and draw DH, cutting off EN for the perspective width. Raise the perpendiculars EM, LK, and NO, for the three angles of the house. Lay the height of the building upon the corner that comes to the ground-line, as EM, and draw MK and MO to their several vanishing points. Also lay all the heights of the doors and windows, and other divisions, upon EM, and draw them to the vanishing points A and B. To lay down the widths of the doors and windows, put their actual widths upon CE, and draw from them to the distance-point I, which cuts off all divisions upon the side LE, and then raise the perpendiculars. The gable-end is found exactly in the same manner as has been described, only taking care to use the proper distance-point H. The manner of finding the width of the chimney is different. Lay off *ba* for the height of the chimney above the top of the gable, and draw *ac* parallel to the horizontal line; then put *ac* equal to the actual thickness of the chimney, and draw *ad* to the vanishing-point A; draw also *cd* to the distance-point I, cutting off *ad* in *d*: then having drawn *ef* from the nearest corner of the chimney, which was found as in fig. 10, draw *df* to the vanishing-point B, cutting off *ef* for the exact perspective width.

Perspective-plane, is the glass or other transparent surface, supposed to be placed between the eye and the object, perpendicularly to the horizon. It is sometimes called the section, table, or glass.

PERSPIRATION, in medicine, the evacuation of the juices of the body through the pores of the skin. Perspiration is distinguished into sensible and insensible; and here sensible perspiration is the same with sweating, and insensible perspiration that which escapes the notice of the senses; and this last is the idea affixed to the word *perspiration* when used alone.

PERSPICUITY, properly signifies the property which any thing has of being easily seen through; hence it is generally applied to such writings or discourses as are easily understood.

PERU, *Balsam of.* This substance is obtained from the myroxylon peruiferum, which grows in the warmer parts of South America. The tree is full of resin, and the balsam is obtained by boiling the twigs in water. It has the consistency of honey, a brown colour, an agreeable smell, and a hot acrid taste.

PETAL, among botanists, an appellation given to the flower-leaves, in opposition to folia, or common leaves of the plant.

PETARD, in the art of war, a metalline engine, somewhat resembling a high crowned hat. Its use is in a clandestine attack to break down gates, bridges, barriers, &c. to which it is hung; and this it does by means of the wooden plank. It is also used in counter-mines to break through the enemy's galleries, and give their mines vent.

PETITIO PRINCIPII, in logic, the taking a thing for true, and drawing conclusions from it as such, when it is really false, or at least wants to be proved, before any inferences can be deduced from it.

PETITION. No petition to the king, or to either house of parliament, for any alteration in church or state, shall be signed by above twenty persons, unless the matter thereof is approved by three justices of the peace, or the major part of the grand jury in the county; and in London by the Lord Mayor, aldermen, and common council: nor shall any petition be presented by more than ten persons at a time.

PETRIFACTION, in natural history, denotes the conversion of wood, bones, and other substances, principally animal or vegetable, into stone.

Petrifactions. Stony matters deposited either in the way of incrustation, or within the cavities of organised substances, are called petrifactions. Calcareous earth being universally diffused and capable of solution in water, either alone, or by the medium of carbonic acid or sulphuric acid, which are likewise very abundant, is deposited whenever the water or the acid becomes dissipated. In this way we have incrustations of limestone or of selenite in the form of stalactites or dropstones from the roofs of caverns, and in various other situations.

The most remarkable observations relative to petrifactions are thus given by Kirwan:—

1. That those of shells are found on, or near, the surface of the earth; those of fish deeper; and those of wood deepest. Shells in specie are found in immense quantities at considerable depths.

2. That those organic substances that resist putrefaction most, are frequently found petrified; such as shells and the harder species of woods: on the contrary, those that are aptest to putrefy are rarely found petrified; as fish, and the softer parts of animals, &c.

3. That they are most commonly found in strata of marle, chalk, limestone, or clay, seldom in sandstone, still more rarely in gypsum; but never in gneiss, granite, basaltes, or shorle; but they sometimes occur among pyrites, and ores of iron, copper, and silver, and almost always consist of that species of earth, stone, or other mineral that surrounds them, sometimes of silex, agate, or cornelian.

4. That they are found in climates where their originals could not have existed.

5. That those found in slate or clay are compressed and flattened.

PETROLEUM. See Bitumen.

PETROMYZON, the *lamprey*, a genus of fishes belonging to the class of amphibia nantes. It has seven spiracula at the side of the neck, no gills, a fistula on the top of the head, and no breast or belly fins. There are eight species, distinguished by peculiarities in their back fins.

PETUNSE. See Porcelain.

PEWTER, which is commonly called *etain* in France, and generally confounded there with true tin, is a compound metal, the basis of which is tin. The best sort consists of tin alloyed with about a twentieth or less of copper or other metallic bodies, as the experience

of the workmen has shown to be the most conducive to the improvement of its hardness and colour, such as lead, zinc, bismuth, and antimony. There are three sorts of pewter, distinguished by the names of plate, trifle, and ley-pewter. The first was formerly much used for plates and dishes; of the second are made the pints, quarts, and other measures of beer; and of the ley-pewter, wine measures and large vessels. The best sort of pewter consists of 17 parts of antimony to 100 parts of tin; but the French add a little copper to this kind of pewter.

PHAETON, in ornithology, a genus of birds belonging to the order of anseres, the characters of which are: The bill is sharp, straight, and pointed; the nostrils are oblong, and the hinder toe is turned forward. There are two species, viz.

1. The *demersus*, or red-footed pinguin, has a thick, arched, red bill; the head, hind part of the neck, and the back, of a dusky purplish hue, and breast and belly white; brown wings, with the tips of the feathers white; instead of a tail, a few black bristles; and red legs. It is found on Pinguin isle, near the Cape of Good Hope, is common all over the South Seas, and is about the size of a goose.

2. The *ethereus*, or tropic bird, is about the size of a partridge, and has very long wings. The bill is red, with an angle under the lower mandible. The eyes are encompassed with black, which ends in a point towards the back of the head. Three or four of the larger quill-feathers towards their ends are black, tipped with white; all the rest of the bird is white, except the back, which is variegated with curved lines of black. The legs and feet are of a vermilion red. The toes are webbed. The tail consists of two long straight narrow feathers, almost of equal breadth from their quills to their points.

PHALÆNA, *moth*, a genus of insects of the order lepidoptera: the generic character is; antennæ cetaceous, gradually lessening from base to tip; wings (when sitting) generally deflex (flight nocturnal.) This genus, like that of papilio, containing a vast number of species, is divided into assortments, according to the different habits of the animals.

PHALLUS, the morel, a genus of the order of fungi, belonging to the cryptogamia class of plants. The fungus is reticulated above, and smooth below. There are three species.

PHANTASMAGORIA, or the raising of spectres, is a term applied to the exhibition of an optical apparatus similar to the magic lantern. See Optics.

PHARMACY, is the art of preparing, compounding, and preserving medicinals.

The preservation of medicines merely consists in the application of rules for collecting vegetable, animal, and mineral productions, at certain seasons, or under particular circumstances, and of ensuring them against the injuries they would suffer by exposure to light, heat, air, moisture, &c.; this, therefore, is the least extensive, and peculiar department of the pharmaceutic art. It is the preparation and composition of medicinals that constitute the principal objects of this science.

PHASEOLUS, *kidney-bean*, a genus of the diadelphia decandria class of plants, the corolla whereof is papilionaceous; the vexillum cordated, emarginated, and reclined with reflex sides; the alæ are roundish, of the same length with the vexillum, and stand upon long ungues; the carina is narrow, and revolves spirally in a contrary direction to the sun; the fruit is a long, straight, coriaceous, and obtuse pod; the seeds are oblong, compressed, and kidney-shaped. There are 21 species.

PHASES. See Astronomy.

PHASIANUS, the *pheasant*, in natural history, a genus of birds of the order gallinæ. Generic character: bill short, strong, and convex, head covered in some degree with carunculated flesh; legs generally with spurs. There are ten species.

Phasianus gallus, or the wild pheasant, inhabits the forests of India, and has been seen, indeed, by navigators, in almost all the Indian and South Sea islands.

Phasianus gallus, or the dunghill cock. The most interesting animal under this variety, is the game cock; which is found in greater perfection of vigour and courage in England, than in any other country; and the irascibility and jealousy of which has, in almost all ages, occasioned it to be employed in the brutal diversion of cock-fighting.

PHILOLOGY, a science, or rather assemblage of several sciences, consisting of grammar, rhetoric, poetry, antiquities, history, and criticism. Philology is a kind of universal literature, conversant about all the sciences, their rise, progress, authors, &c. It makes what the French call the *belles lettres*. In the universities it is called humanities. Anciently philology was only a part of grammar.

PHILOSOPHER, a person versed in philosophy; or one who makes profession of, or applies himself to, the study of nature and morality.

PHILOSOPHY, or the love of wisdom, is a term applied to the doctrines that have at different times, and by different men, been asserted and propagated in the world. Of these the following slight sketch may be of service to the young student.

1. *Pythagorean philosophy* was taught by the philosophers who adhered to the doctrines of Pythagoras, who flourished about 500 years before Christ. They taught that there is one God, an incorruptible and invisible Being, and therefore only to be worshipped with a pure mind; and that there is a relationship between the gods and man, which is supposed to have been borrowed from the Christian doctrine of Providence. They asserted a transmigration of souls, and therefore the immortality of the soul. They taught that virtue is harmony, health, and every good thing, and inculcated in an impressive manner the duties of children towards their parents. The disciples of this school were exhorted to cherish sentiments honourable to the female sex.

2. *Aristotelian philosophy.*—This was taught by Aristotle, and maintained by his followers; it was also called *peripatetic*. Aristotle was a disciple of Plato; but his system differed greatly from that of his master. Without enumerating his principles, it may be observed that most of them were false, and his reasonings inconclusive.

3. *Peripatetic philosophy*, so called from a sect of philosophers the followers of Aristotle.

Cicero tells us that Plato left two excellent disciples, Xenocrates and Aristotle, who founded two sects, who differed in name. The former called academics, because they held their conferences in the academy: the latter, who followed Aristotle, were called peripatetics, or walkers, because they disputed walking in the lyceum or school.

4. *Socratic philosophy.*—This comprised the doctrines and opinions with regard to morality and religion, maintained and taught by Socrates about 400 years before Christ. Socrates was one of the best and wisest persons in the heathen world. The first introduction of moral philosophy is ascribed to him. He it was that led men from the contemplation of the heavens to consider *themselves,* their own passions, opinions, faculties, duties, and actions. It was he who, when all the other philosophers boasted that they knew all things, first owned that he knew nothing but this, *that he knew nothing.* Socrates wrote nothing himself, yet almost all the sects of Greece refer their origin to his discipline. The genuine principles of his philosophy are stated in the Memorabilia of Xenophon. Plato by attributing to his master conceptions, sublime indeed, but evidently borrowed from, and embellished with the mythology of, the Pythagorean school, has rendered his writings on this point apocryphal.

5. *Platonic philosophy.*—This was founded by Plato, who lived about 350 years before Christ. It appears to have been drawn from traditions founded upon early revelations: from scattered fragments of the ancient patriarchal creed: and there is scarcely any thing good or commendable said of the Deity, but what he had from ancient creeds, which prevailed before the general defection to idolatry. Plato confesses that the Greeks borrowed their knowledge of the one infinite God from an ancient people, better and nearer to God than they. His account of man's state of innocence—that he was born of the earth—that he was naked—that he enjoyed a truly happy state—that he conversed with brutes—that a personage was expected, who would give mankind a model for devotion, &c.; in short, all parts of his philosophy bear evident marks of being derived from Revelation.

6. *Academic philosophy* was originally derived from Socrates and Plato, who taught in a grove near Athens, consecrated to the memory of Academus, an Athenian hero. Labour and caution in their researches, in opposition to rash and hasty decisions, were the distinguishing characteristics of the disciples of the ancient academy. The sceptical notions of Arcesilaus, Carneades, and the other disciples of the succeeding academics, were of a very opposite nature to those which were inculcated by Socrates and Plato.

7. *Cyrenaic philosophy,* so called from Aristippus of Cyrene, a disciple of Socrates. Their leading tenets were unfriendly to virtue and the welfare of society. This sect was afterwards divided into three branches, when it soon languished, and sunk into deserved obscurity.

8. *Epicurean philosophy,* so named from Epicurus the founder. The Epicureans have in all ages been decried for their morals and their attachment to the pleasures of sense; and in the common use of the word, Epicurean signifies an indolent, effeminate, and voluptuous person. But there were two kinds of Epicureans, the rigid and the remiss. The *rigid* were strictly attached to the sentiments of Epicurus, and placed all their happiness in the pure pleasures of the mind, resulting from the practice of virtue. The *remiss* placed all their happiness in pleasures of the body, in eating, drinking, &c. The former, who were the genuine Epicureans, called the others the sophists of their sect. Epicurus flourished more than 300 years before Christ.

9. *Stoic philosophy* includes the followers of Zeno; so called because Zeno used to teach under a portico or piazza. He is supposed to have borrowed many of his dogmata from the Phœnician philosophy, which was, in fact, taken from the Jewish. Many things also appear to be borrowed from the schools of Socrates and Plato. The morality of the Stoics was couched in paradoxes:—as, the wise man is void of all passion and perturbation of mind—that pain is no real evil—that a wise man is happy in the midst of the severest torture—that a wise man is always the same, and always joyful—that none but a wise man is free and rich, or ought to be esteemed or acknowledged as a king, magistrate, poet, or philosopher—that all wise men are great—that all things are a wise man's who is contented with himself—that wise men are the only true friends and lovers—that nothing ever happens to a wise man beyond expectation—that all good things are equal, and equally to be desired—and that goodness admits of no increase or diminution; with many others. They acknowledged one God, whom they called *mind, fate, Jupiter,* and believed that the human soul survived the body.

10. *Cynic philosophy.*—The disciples of this sect valued themselves upon a contempt of every thing, especially riches and estates, arts and sciences; all excepting morality. The founder of this sect was Antisthenes, a disciple of Socrates, nearly 400 years before Christ. He was called an ingenuous and sincere *dog,* it being the distinguished character of the Cynics to attack and bark at the wicked, and to defend and fawn on the good; hence they were called Cynics. Antisthenes had an academy not far from the gates of Athens. There is an affinity between the Stoics and the Cynics; but the former were more modest and reserved than the latter, who are said to have banished all shame. Diogenes was of this sect; he lived 380 years before Christ.

11. *Sceptic philosophy.*—The doctrines and opinions of the Sceptics, called also Pyrrhonism, from its author Pyrrho, who lived about 500 years before Christ. The ancient scepticism consisted in doubting of every thing, in affirming nothing, and in keeping the judgment in suspense on every thing. Socrates, as was before observed, used to say, 'I know nothing but this, that I know nothing:' which the Sceptics altered to this, 'I know nothing, not even this; that I know nothing.'

In concluding these observations on the ancient philosophy and philosophers, it may be observed that *Scripture* was the basis, or rather the chief source whence the heathens of Greece and Rome drew their fables;—they founded their tenets on the first principles of religion Their philosophy seemed but a prelude to that

conversion of them which God had so frequently predicted by his prophets. The truths of the Christian religion they thus inculcated to their disciples; and what is more remarkable, taught almost 400 years before the light of the gospel had shed its blessings on the world. Plato began to write immediately after the three last prophets that were in Israel. When the prophets ceased among the Jews, God raised these philosophers to illuminate the Gentiles. Thus many of the principles of the gospel were publicly taught at Athens. The philosophers instructed their scholars in the belief of one God; that they ought to love and serve him, and to endeavour to resemble him in holiness and righteousness; and that this God rewards humility, and punishes pride; with many other tenets nearly similar to those contained in the gospel.

PHLEBOTOMY, in surgery, the opening a vein with a proper sharp-edged and pointed instrument of steel, in order to let out a proper quantity of blood, either for the preservation, or recovery, of a person's health.

PHLOAS, a genus of vermes testacea; the animal an ascidia; shell bivalve, divaricate, with several lesser differently shaped accessory ones at the hinge; hinges recurved united by a cartilage: in the inside, beneath the hinge, is an incurved tooth. The inhabitants of this genus perforate clay, spongy stones and wood, while in the younger state; and as they increase in size, enlarge their habitation within, and thus become imprisoned. They contain a phosphorous liquor of great brilliancy in the dark, and which illuminates whatever it touches or happens to fall upon. There are 12 species.

PHLOMIS, the *sage-tree*, or *Jerusalem sage*, a genus of the gymnospermia order, in the didynamia class of plants. The calyx is angular; corolla, upper lip incumbent, compressed, villose. There are 22 species, all of which have perennial roots, and of many the stalks also are perennial.

PHOCA, *seal*, a genus of quadrupeds of the order feræ. The generic character is, fore-teeth in the upper jaw six, pointed, parallel, the exterior larger; in the lower jaw four, bluntish, parallel, distinct, equal canine teeth one on each side in both jaws, large, pointed; the upper ones distinct from the cutting-teeth, the lower from the grinders; grinders, five on each side above, six below, obtusely tricuspidated. There are about 19 species.

PHŒNICOPTERUS, or FLAMINGO, in ornithology, a genus of birds belonging to the order of grallæ. The beak is naked, toothed, and bent, as if it was broken; the nostrils are linear; the feet are palmated, and four-toed. There is but one species, viz. the Bahamensis of Catesby, a native of Africa and America.

This bird resembles the heron in shape, excepting the bill, which is of a very singular form. It is two years old before it arrives at its perfect colour, and then it is entirely red, excepting the quill feathers, which are black. A full-grown one is of equal weight with a wild duck; and when it stands erect, it is five feet high. The feet are webbed. The flesh is delicate, and most resembles that of a partridge in taste. These birds make their nests on hillocks in shallow water, on which they sit with their legs extended down, like a man sitting on a stool. They breed on the coasts of Cuba and the Bahama islands in the West Indies, and frequent salt water only.

PHŒNIX, the *great palm*, or *date-tree*, a genus of plants belonging to the order palmæ. The calyx is 3-parted; corolla 3-petalled; male stamina three; female pist. one, drupe ovate. There is only one species, viz. the dactylifera, or common date-tree, a native of Africa and the Eastern countries, where it grows to 50, 60, and 100 feet high.

PHOSPHATS, salts formed by the phosphoric acid, with the alkalis, earths, and metallic oxides. They may be distinguished by the following properties: 1. When heated with combustibles, they are not decomposed, nor is phosphorous obtained. 2. Before the blowpipe they are converted into a globule of glass, which in some cases is transparent, in others opaque. 3. Soluble in nitric acid without effervescence, and precipitated from that solution by lime-water. 4. Decomposed, at least partially, by sulphuric acid; and their acid, which is separated, when mixed with charcoal, and heated to redness, yields phosphorus. 5. After being strongly heated, they often phosphoresce.

The phosphats readily combine with an excess of acid, and form superphosphats.

The phosphats at present known amount to 12; two of which are triple salts.

PHOSPHITES, salts formed with the phosphorus acid united to the earths, alkalis, and metallic oxides. These salts may be distinguished by the following properties: 1. When heated, they emit a phosphorescent flame. 2. When distilled in a strong heat, they give out a little phosphorus, and are converted into phosphats. 3. They detonate when heated with nitrat or oxymuriat of potass, and are converted into phosphats. 4. They may be converted into phosphats by nitric and oxymuriatic acid. 5. They are fusible in a violent heat into glass. The phosphites at present known amount to eight.

PHOSPHORIC ACID. The base of this acid, or the acid itself, abounds in the mineral, vegetable, and animal kingdoms. In the mineral kingdom it is found in combination with lead, in the green lead ore; with iron, in the bog ores which afford cold short iron; and more especially with calcareous earth in several kinds of stones. Whole mountains in the province of Estremadura in Spain are composed of this combination of phosphoric acid and lime.

In the animal kingdom it is found in almost every part of the bodies of animals which are not considerably volatile. There is not, in all probability, any part of these organized beings which is free from it. It has been obtained from blood, flesh, both of land and water animals; from cheese; and it exists in large quantities in bones, combined with calcareous earth. Urine contains it, not only in a disengaged state, but also combined with ammonia, soda, and lime.

PHOSPHORUS. If phosphoric acid be mixed with 1-5th of its weight of powdered charcoal, and the mixture distilled at a moderate red heat, in a coated earthen retort, whose beak is partially immersed in a basin of water, drops of a waxy-looking substance will pass

over, and, falling into the water, will concrete into the solid called phosphorus. It must be purified, by straining it through a piece of chamois leather, under watm water. It is yellow and semitransparent. It is as soft as wax, but fully more cohesive and ductile. Its sp. gr. is 1.77. It melts at 90° F. and boils at 550 degrees.

When phosphorus is heated in the air to about 148°, it takes fire, and burns with a splendid white light, and a copious dense smoke. If the combustion take place within a large glass receiver, the smoke becomes condensed into snowy looking particles, which fall in a successive shower, coating the bottom plate with a spongy white efflorescence of phosphoric acid. This acid snow soon liquefies by the absorption of aqueous vapour from the air.

When phosphorus is inflamed in oxygen, the light and heat are incomparably more intense; the former dazzling the eye, and the latter cracking the glass vessel.

PHOSPHURETS, substances formed by an union of the alkalis, earths, and metallic oxides, with phosphorus. Thus we have phosphuret of lime, &c.

PHOTOMETER, an instrument intended to indicate the different quantities of light, as in a cloudy or bright day, or between bodies illuminated in different degrees. Mr. Leslie has invented an instrument of this kind, the essential part of which consists of a glass tube like a reversed syphon, whose two branches should be equal in height, and terminated by balls of equal diameter; one of the balls is of black enamel, and the other of common glass into which is put some liquid.

The motions of the liquor, which is sulphuric acid tinged red with carmine, are measured by means of a graduation, the zero is situated towards the top of the branch that is terminated by the enamelled ball. The use of this instrument is founded upon the principle, that when the light is absorbed by a body, it produces a heat proportional to the quantity of absorption. When the instrument is exposed to the solar rays, those rays that are absorbed by the dark colour, heat the interior air, which causes the liquor to descend at first with rapidity in the corresponding branch. But as a part of the heat which had introduced itself by means of the absorption is dissipated by the radiation, and as the difference between the quantity of heat lost, and that of the heat acquired goes on diminishing, there will be a point where these two quantities having become equal, the instrument will be stationary, and the intensity of the incident light is then estimated by the number of degrees which the liquor has run over.

The author of this ingenious instrument has pointed out its advantages in determining the progressive augmentation undergone by the intensity of the light, and the gradation in a contrary sense which succeeds to that progress, both from the beginning of the day to its end, and from the winter solstice to the end of the succeeding autumn. With the help of such an instrument one might also compare the action of rays of light in different countries of which some dart with sufficient constancy from a fine and serene sky, while others seem to be covered with a veil which dims and obscures their lustre.

PHRENOLOGY, from φρην *mind*, and λογος *a discourse*, is the name applied to a science which, though by no means new, has not till very recently attracted the attention of the public. Phrenology, says Mr. George Combe, in his excellent little work on the subject treats of the faculties of the human mind, and of the organs by which they manifest themselves; but it does not enable us to predict actions. Dr. Gall, a physician of Vienna, appears to have been the founder of the system, and for the first time delivered lectures on it in 1796 In 1800, Dr. J. G. Spurzheim began to study this doctrine under Dr. Gall; and in 1804 was associated with him in his labours. Since that time he has added much to the discoveries of Dr. Gall; and indeed to him we are principally indebted for the high ground on which the system stands in Britain at the present day.

This system, although yet in its infancy, promises to effect great things. Much alarm has been excited by it among those who are reckoned the great defenders of the Christian religion, as if its tendency were towards the foolish and gloomy doctrine of materialism: this, however, is only a strong proof that they have never examined the subject with sufficient care; or rather it is a proof of the insufficiency of their own system to afford satisfaction on topics of great interest to minds that are expanding by the benign influence of science. The subject of phrenology has met with the greatest encouragement in this country. In the city of Edinburgh, where there is a regularly organized society composed of men of respectability and superior talent; the reports of this society are regularly published, in addition to which they issue a Magazine, embracing discussions in any way suited to elicit information on the grand object of their researches.' We shall here present our readers with an abstract of the doctrine of phrenology, as exhibited in the most recent productions of its advocates, merely farther observing, that the general developement of the different organs is by a protuberance in that part of the head where they are respectively situated, and by the proportion which that protuberance bears to the rest of the skull and the adjoining organs. The numbers refer to the different regions of the map of the head as laid down by phrenologists. See plate XLIV.

1. **Amativeness.** The cerebellum is the organ of this propensity; it is situated between the maistoid process on each side, and the projecting point in the middle of the transverse ridge of the occipital bone: i. e. at the back of the neck or lower part of the head. The size is indicated by the thickness of the neck at these parts. *Function.* The sexual passions.

y.

2. **Philoprogenitiveness.** Above the middle part of the cerebellum, corresponding to the general protuberance of the occiput it is above amativeness. *Function.* The instinctive love of offspring in general. Parental affection.

3. **Concentrativeness.** Above philoprogenitiveness, and below self-esteem. *Function* The faculty of concentrating several powers t one object. Study.

4. **Adhesiveness.** On each side of concentrativeness, above philoprogenitiveness, and just above the lambdoidal suture. *Function.* The instinctive tendency to attach ourselves to others, to animals, or to objects. Friendship.

5. **Combativeness.** At the inferior and mastoid angle of the parietal bone, behind the ear, next to philoprogenitiveness and adhesiveness. *Function.* Courage, and the propensity to attack. Quarrelsomeness.

6. **Destructiveness.** Above the ear, corresponding to the squamous plate of the temporal bone, below secretiveness, and next to combativeness. *Function.* Desire to destroy in general. Murder.

7. **Constructiveness.** At that part of the frontal bone, above the spheno-temporal suture next acquisitiveness, about 1½ inch from the eye, and nearly in a line with destructiveness. *Function.* The tendency to construct in general. Mechanical skill.

8. **Acquisitiveness.** At the anterior inferior angle of the parietal bone, between constructiveness and secretiveness. *Function.* Desire to possess in general. Avarice, theft.

9. **Secretiveness.** At the inferior edge of the parietal bones, above destructiveness, or in the middle of the lateral portion of the brain. *Function.* Tendency to conceal. Cunning, deceit.

SENTIMENTS.

10. **Self-esteem.** At the top of the head above the posterior, or sagittal angle of the parietal bones, above concentrativeness. *Function.* Self-love in general. Dignity, conceit, pride, selfishness.

11. **Love of Approbation.** On each side of self-esteem, about half an inch from the lambdoidal suture. *Function.* Love of other's esteem, and the expression of it in praise, bashfulness, fame.

12. **Cautiousness.** Near the middle of the parietal bone, where ossification generally begins, love of approbation and secretiveness. *Function.* The emotion of fear in general. Care, deliberation, doubt, panic.

13. **Benevolence.** At the upper part of the frontal bone, in the coronal aspect, before the fontanel, above the brow, next veneration. *Function.* Desire of the happiness of others. Philanthropy, hospitality.

14. **Veneration.** At the middle of the coronal aspect, at the bregma, or fontanel, between benevolence and firmness. *Function.* The sentiments of respect, reverence, and adoration. Religion, idolatry, toryism.

15. **Hope.** On each side of veneration, under part of the frontal, and part of the parietal bones. *Function.* Tendency to believe in the possibility of obtaining our desires. Belief, credulity.

16. **Ideality.** Along the lower edge of the temporal ridge of the frontal bone, above acquisitiveness. *Function.* The feeling of exquisiteness and perfectibility. Sensations of sublime and beautiful. Fine Arts. Enthusiasm.

17. **Wonder.** Above Ideality. *Function.* Sensations of novelty, surprise, astonishment. News. mystery, supernatural agency.

18. **Conscientiousness.** On the posterior and lateral parts of the coronal surface of the brain, above Cautiousness, behind Hope. *Function.* Feelings of right and wrong. Justice. Duty.

19. **Firmness.** At the posterior part of the coronal surface of the head, close upon the middle line, between self-esteem and veneration. *Function.* To produce determination, constancy, perseverance, and fortitude. Decision of character, obstinacy, stubbornness, infatuation.

INTELLECT.

20. **Individuality.** In the middle of the lower part of the forehead, or brow, below comparison, Nos. 1 and 2. *Function.* The desire and ability to know facts and things. Philosophy, science, metaphor.

21. **Form.** Between the eyes; the degrees of this organ correspond to the greater or less development of brain, situate on the mesial, or inner side of the orbitary plates of the frontal bone, on each side of the *crista galli*. *Function.* To judge of form, to distinguish faces. Imitative arts.

22. **Size.** Above the eyes: below locality. *Function.* Facility in estimating size. Perspective.

23. **Weight or Resistance.** Above the eyes; next size. *Function.* To judge of the weight, resistance, or momentum of bodies. Laws of mechanics.

24. **Colouring.** Above the eyes: next weight. *Function.* To perceive colours. Painting, dyeing, &c.

25. **Locality.** Above size and weight. *Function.* Local memory. Desire for travelling. Topography, geography, astronomy, landscape, painting, &c.

26. **Order.** Above the eyes; between colouring and number. *Function.* Love of order and arrangement. Desire to see every thing in its place.

27. **Time.** Above colouring and locality. *Function.* Recollection of dates, judging of time and of intervals in general. Chronology, association.

28. **Number.** The arch of the eye-brow is either much pressed downward, or there is an elevation at the external angle of the orbit next Order. *Function.* The conception of number and its relations. Arithmetic, algebra, logarithms.

29. **Tune.** In the lateral part of the forehead, between constructiveness and wit, *Function.* The perception of melody. Taste for music.

30. **Language.** In the eyes. *Function.* Faculty of acquiring the knowledge and the use of language. Style, volubility, verbal memory.

31. **Comparison.** In the upper and middle portion of the frontal bone, between benevolence and individuality. *Function.* Power of perceiving resemblances, similitudes, analogies, and coincidences. Reasoning by comparison, proverbs, parables,

32. **Causality.** In the upper part of the frontal bone, on each side of comparison. *Function.* Desire to discover causes and their connection with effects. Deep penetration, genius for metaphysics, political economy, and similar sciences. Speculation, abstraction.

33. **Wit.** In the anterior-superior-lateral parts of the forehead, between casualty and Tune. *Function.* Disposition to view objects in a ludicrous light. Humour, joke satire, epigrams.

34. **Imitation.** In the superior-anterior portion of the head, on the two sides of benevolence, rising up in the form of a segment of a circle. *Function.* The power of imitation in general. Found in artists, players, painters, sculptors, engravers, &c.

We cannot quit this subject without venturing a prediction, which we firmly believe a few years will verify. viz. that phrenology, when better understood, and more amply confirmed by experience, will be found to diffuse a flood of light over many parts of the Old Testament Scriptures, which at present appear obscure and uninteresting.

PHYLACTERY, in antiquity, a charm or amulet, which being worn, was supposed to preserve people from certain evils, diseases, and dangers. The Jews were remarkable for wearing phylacteries of parchment, in the form of slips or rolls, wherein were written certain passages of the law: these they wore upon their foreheads, and upon the wrists of their left arms. See Matthew, chap. xxiii.

PHYSETER, **Cachalot**, a genus of fishes of the order cete. The generic character is, teeth visible in the lower jaw only; spiracle on the head or snout. 1. Physeter macrocephalus, blunt-headed cachalot. This whale, which is one of the largest species, is scarcely inferior in size to the great mysticete, often measuring sixty feet or more in length. The head is of enormous size, constituting more than a third of the whole animal; the mouth wide; the upper lip rounded, thick or high, and much broader than the lower; which is of a somewhat sharpish form, fitting in a manner, into a longitudinal bed or groove in the upper. The teeth, at least the visible ones, as mentioned in the generic character, are situated only in the lower jaw; and when the mouth is closed, are received into so many corresponding holes or cavities in the upper: they are pretty numerous, rather blunt, and of a somewhat conic form, with a very slight bend or inclination inwards. There are also, according to Fabricius, small curved, flattish, concave, and sharp-pointed teeth, lying almost horizontally along the upper jaw; though, from their peculiar situation and size, they are not visible like those of the lower; being imbedded in the fleshy interstices of the holes which receive the lower teeth, and presenting only their internal concave surfaces to meet the latter when the mouth is closed. The front of the head is very abrupt, descending perpendicularly downwards; and on its top, which has been improperly termed the neck by some authors, is an elevation or angular prominence containing the spiracle, which appears externally simple, but is double within. The head is distinguished or separated from the body by a transverse furrow or wrinkle. The eyes are small and black: and the ears or auditory passages extremely small. About the middle of the back is a kind of spurious fin, or dorsal tubercle, of a callous nature, not moveable, and somewhat abrupt or cut off behind. The tongue is of the shape of the lower jaw, clay-coloured externally, and of a dull red within. out is but small in proportion to the animal. The body is cylindrical beyond the pectoral fins, growing narrower towards the tail. The colour of the whole animal is black, but when advanced in age grows whitish beneath. It swims swiftly, and is said to be a violent enemy to the squalus carcharias, or white shark, which is sometimes driven ashore in its endeavours to escape, and according to Fabricius, will not venture to approach its enemy, even when dead, though fond of preying on other dead whales.

It is in a vast cavity within the upper part of the head of this whale, that the substance called spermaceti is found, which while fresh and in its natural receptacle, is nearly fluid; but when exposed to the air, concretes into opake masses: this substance being so universally known, it becomes unnecessary to describe it further.

A more curious and valuable production, the origin of which had long eluded the investigation of naturalists, is obtained from this animal, viz. the celebrated perfume called ambergris, which is found in large masses in the intestines, being in reality no other than the fæces.

Physician, one who professes medicine, or the art of healing diseases. See Medicine.

PHYSICS, a term made use of by Dr. Keil and others, for natural philosophy, explains the doctrine of natural bodies, their phenomena, causes, and effects, with the various affections, motions, and operations. Experimental physics inquire into the reasons and nature of things by experiments, as in hydrostatics, pneumatics, optics, &c. but more particularly in chemistry, in which more has been done the last thirty years than could possibly have been conceived by the imagination. Mechanical physics explain the appearances of nature from the matter, motion, structure, and figures of bodies, and their parts, according to the settled laws of nature.

PHYSIOGNOMY, is a term applied to the peculiar combination of features, which designates the feelings and dispositions of the mind. That every individual of the human race possesses a set of distinctive marks, in the form of the head and the outlines of the countenance, is visible to the most inattentive observer; and it is well known, that those marks insensibly lead us to form conclusions as to the nature and inclinations of persons to whom we are introduced for the first time, which may sometimes be correct, but are frequently erroneous.

This subject, which, for a considerable time, has occupied the attention of philosophers, has now assumed a new name, and the reader will find a short notice of it under the term phrenology.

PHYSIOLOGY, is the science which treats of the powers that actuate the component parts of living animal bodies, and of the functions which those bodies execute.

This science embraces a most extensive field of investigation, indeed the most extensive of any to which the human powers are at all adequate; on this account we would not attempt even an outline of it, but refer the reader to those works in which it is to be found, treated of at large, amongst which the productions of Haller, Richerand, Blumenbach and Lawrence, hold a conspicuous place.

PHYTOLOGY, a discourse concerning the kinds and virtues of plants.

PHYTOTAMA, a genus of birds of the

order passeres; the generic character is, bill conic straight, serrate; nostrils oval; tongue short, obtuse; feet four-toed. There is only a single species viz. P. rara, that inhabits Chili, nearly equal in size to the quail;

PIA MATER. See ANATOMY.

PICA. See MUS.

PICÆ, the second order of birds, according to the Linnæan system. They are distinguished by a bill sharp-edged, convex above; legs short, strong, feet formed for walking, perching, or climbing; body toughish, impure; food various, filthy substances; nest in trees; the male feeds the female while she is sitting. They live in pairs. Of this order there are twenty-six genera.

PICQUET, a celebrated game at cards played between two persons, with only thirty-two cards; all the twos, threes, fours, fives, and sixes, being set aside.

PICUS, the *woodpecker*, in ornithology, a genus belonging to the order of picæ. The beak is straight, and consists of many sides, and like a wedge at the point: the nostrils are covered with bristly feathers; the tongue is round like a worm, very long and sharp at the point, which is beset with bristles bent backwards.

The grand characteristic of these birds is the tongue, the muscles necessary to the motions of which are singular and worthy of notice, affording the animal means of darting it forwards the whole length, or drawing it within the mouth at will. Latham enumerates no less than 50 different species of woodpeckers, besides varieties of some of them which amount to nine more.

PIEPOUDRE, *Court of*, the lowest, and at the same time the most expeditious, court of justice known to the law of England. It is a court of record, incident to every fair and market; and of which the steward of him who holds the toll of the market is the judge. It was instituted to administer justice for all commercial injuries done in that very fair or market, and not in any preceding one; so that the injury must be done, complained of, heard and determined, within the compass of one and the same day, unless the fair continues longer.

PIGEONS. Every person who shall shoot at, kill, or destroy a pigeon, may be committed to the common jail for three months, by two justices of the peace, or pay 20*s* to the poor.

PIKE, an offensive weapon, consisting of a shaft of wood, twelve or fourteen feet long, headed with a flat-pointed steel, called the spear.

PILASTAS. See ARCHITECTURE.

PILE, in artillery, denotes a collection or heap of shot or shells, piled up by horizontal courses into either a pyramidal or else a wedgelike form: the base being an equilateral triangle, a square, or a rectangle. In the triangle and square, the pile terminates in a single ball or point, and forms a pyramid.

PILOT, a person employed to conduct ships over bars and sands, or through intricate channels, into a road or harbour.

PIN, in commerce, a little necessary instrument made of brass wire, chiefly used by women in adjusting their dress.

PINCHBECK, an alloy containing three parts of zinc, and four of copper: it assumes the colour of gold, but it is not so malleable as brass. See ZINC.

PINE. See PINUS.

PINE-APPLE. See BROMELIA.

PINGUIN, or PENGUIN. See APTENODYTES.

PINION, in mechanics, an arbor, or spindle, in the body whereof are several notches, which catch the teeth of a wheel that serves to turn it round; or it is a lesser wheel which plays in the teeth of a larger.

PINITE, a mineral that has received its name from Pini in Saxony, where it has been found in granite. Its colour is reddish brown or black; always in crystals, either rhomboidal prisms, or six sided prisms; sometimes entire; sometimes having their alternate lateral edges truncated: sometimes whole; surface smooth and brilliant; fracture uneven, passing to conchoidal; specific gravity 2.9.

PINK, a vessel used at sea, masted and rigged like other ships, only that this is built with a round stern: the bends and ribs compassing so as that her sides bulge out very much.

PINK. See *Dianthus*.

PINNA, in zoology, a genus belonging to the order of vermes testaceæ. The animal is a slug. The shell is bivalve, fragile, and furnished with a beard, gapes at one end; the valves hinge without a tooth.

PINNACE, a small vessel used at sea with a square stern, having sails and oars, and carrying three masts, chiefly used as a scout for intelligence, and for landing of men, &c. One of the boats belonging to a great man of war, serving to carry the officers to and from the shore, is also called the pinnace.

PINUS, the *pine tree*, a genus of the monadelphia order, in the monœcia class of plants. The male calyx is four-leaved; no corolla; stamina very many, with naked anthers: fem. cal. strobiles, with a two-flowered scale; corolla none; pistil one; nut with a membraneous wing. There are 21 species of this genus.

PIONEERS, in the art of war, are such as are commanded in from the country, to march with an army for mending the ways, for working on entrenchments and fortifications, and for making mines and approaches.

PIP, or *Pep*, pepia, a disease among poultry, consisting of a white thin skin, or film, that grows under the tip of the tongue, and hinders their feeding.

PIPE, in building &c. a canal or conduit, for the conveyance of water and other fluids. Pipes for water, water-engines, &c. are usually of lead, iron, earth, or wood: the latter are commonly made of oak or elder. Those of iron are cast in forges; their usual length is about two feet and a half; several of these are commonly fastened together by means of four screws at each end, with leather or old hat between them, to stop the water. Those of earth are made by the potters; these are fitted into one another, one end being always made wider than the other. To join them the closer, and prevent their breaking, they are covered with tow and pitch: their length is usually about that of the iron pipes. The wooden pipes are trees bored with large iron augurs, of different sizes, beginning with a less, and then proceeding with a larger successively; the first being pointed, the rest formed like spoons, increasing in diameter. from one to six inches or more they are fitted into the extremity of each other, and sold by the foot.

Pipes, *tobacco,* are made of various fashions; long, short, plain, worked, white, varnished, unvarnished, and of various colours, &c. The Turks use pipes three or four feet long, made of rushes, or of wood bored, at the end whereof they fix a kind of pot of baked earth, which serves as a bowl, and which they take off after smoking.

Pipe also denotes a vessel or measure for wine, containing 126 gallons.

PIPER, pepper; a genus of the trigynia order, in the diandria class of plants. There is no calyx or corolla; the berry is one-seeded. There are sixty species, of which the most remarkable is the siriboa, with oval, heart-shaped, nerved leaves, and reflexed spikes. This is the plant which produces the pepper so much used in food. It is a shrub whose root is small, fibrous, and flexible; it rises into a stem, which requires a tree or prop to support it.

PIRATE, one who maintains himself by pillage and robbing at sea. By statute 28, Henry VIII, c. 15, all felonies committed upon the sea, or any place where the Admiral has jurisdiction, shall be tried wherever the king shall appoint by his special commission, as if the offence had been at common law.

And by statute 6, George I. if any subjects or denizens of this kingdom, commits any hostility against others of the king's subjects upon the sea, under colour of any commission from any prince or other authority, he shall be deemed a pirate, and suffer accordingly.

By statute 18, George II. c. 30, persons committing hostilities, or aiding enemies at sea, may be tried as pirates. Piracies at sea are excepted out of the general pardon by 20 George II. c. 52.

PISCES, in natural history, is the fourth class in the Linnæan system, consisting of five orders, viz.

Abdominales	Jugulares
Apodes	Thoracici
Cartilaginii	

The class is described as having incumbent jaws; eggs without white; organs of sense; for covering, imbricate scales; fins for supporters: they swim in water.

Of the various functions of fishes, the most important is that of respiration; this is performed by means of gills, which supply the place of lungs. This process, in fishes, as breathing in the human subject, is carried on during sleep, and is repeated about twenty-five times in a minute; and the necessity of it is evinced from the circumstance of fish being certainly killed in water, from which air is taken away by means of the air-pump, or excluded by very severe frost. Should the free play of the gills be even suspended, or their covers kept from moving, by a string tied round them, the fish would fall into convulsions, and die in a few minutes. It is said, likewise, that though the bronchial apparatus be comprised in a small compass, its surface when fully extended would occupy many square feet; a fact, that may convince the most sceptical, of the numberl[illegible] convolutions and ramifications in which the included water is elaborated and attenuated, in the course of giving out its air in the respiratory process.

Fishes have the organs of sense, some of them probably in a very high degree, and others imperfectly; of the latter kind are the senses of touch and of taste: but the sense of hearing has now been completely ascertained, which was long doubted, and by some physiologists denied; the organ is contained in the cavity of the head.

The organ of smelling is large, and the animals have a power of contracting and dilating the entry to it as they have occasion. It seems to be mostly by their acute smell that they discover their food, for their tongue seems not to have been designed for a very nice sensation, being of a pretty firm cartilaginous substance; and common experience evinces that their sight is not of so much use to them as their smell in searching for their nourishment.

The optic nerves in fishes are not confounded with one another in their middle progress between their origin and the orbit, but the one passes over the other without any communication; so that the nerve which comes from the left side of the brain goes distinctly to the right eye, and *vice versa.*

We must here notice the motion of fishes, for the celerity of which their shape is admirably adapted: hence, vessels designed to be navigated in water are made to imitate, in some degree or other, the shape of fish; but the rapidity of a ship in sailing before the wind is not to be compared to the velocity of a fish. The largest fishes are known to overtake a ship in full sail with the greatest ease, to play round it without effort, and to surpass it at pleasure. Every part of the body seems formed for dispatch: the fins, the tail, and the motion of the whole back-bone assist in the business; and it is to that flexibility of body which mocks the efforts of art, that fishes owe the great velocity of their motions. The chief instruments in a fish's motion are its fins, air-bladder, and tail; with two pair, and three single fins, it will migrate a thousand leagues in a season, and without indicating any visible symptoms of languor or fatigue. The fins serve not only to assist the animal in progression, but in rising and sinking, in turning, and even in leaping out of the water.

By means of the air bladder, fishes can increase or diminish the specific gravity of their body. When they contract it, and press out the air, the bulk of the body is diminished, and the fish sinks as far as it pleases; on relaxing the operation, the bladder acquires its natural size, the body becomes specifically lighter, and the fish is enabled to swim near the surface. The tail, in the last place, may be regarded as the rudder, directing the motions of the fish, to which the fins are only subservient.

With respect to the nourishment of fishes: they are mostly carnivorous, though they seize upon almost any thing that falls in their way, and not uncommonly devour their own offspring: they seem, indeed, to manifest a particular predilection for whatever they can swallow possessed of life. They often meet with each other in fierce opposition, and the victor, without scruple, devours his antagonist. Fishes can, however, notwithstanding their natural voracity, live long, apparently, without food; but they, perhaps, in vases, and other ornamental vessels, feed on insects too small for the human eye to see; or, it has been thought, they

may have the power of chemically decomposing water.

In most, if not in all fishes, there is a difference in sex, though Bloch and others make mention of individuals, which seemed to unite the two sexes, and to be real hermaphrodites. The number of males, it has been remarked is about double that of females; and were it not for this wise provision of nature, a large proportion of the extruded eggs would remain unfecundated. A few species, indeed, as the eel, blenny, &c. are viviparous; but by far the greater number are produced from eggs. These last compose the roe, ovaries of the females, which lie along the abdomen. The milt of the males is disposed along the backbone, in one or two bags, and consists of a whitish glandular substance, which secretes the spermatic fluid.

Fishes have different seasons for depositing their spawn. Some, which live in the depths of the ocean, choose the winter months; but, in general, those with which we are acquainted choose the hottest months in summer, and prefer such water as is somewhat tepified by the beams of the sun. They then leave the deepest parts of the ocean, which are the coldest, and shoal round the coasts, or swim up the fresh-water rivers, which are warm as they are comparatively shallow, depositing their eggs where the sun's influence can most easily reach them, and seeming to take no farther charge of their future progeny. Of the eggs thus deposited, scarcely one in a hundred brings forth an animal, as they are devoured by all the lesser fry which frequent the shores, by aquatic birds near the margin, and by the larger fish in deep water. Still, however, the sea is amply supplied with inhabitants: and notwithstanding their own rapacity, and that of various tribes of fowls, the numbers that escape are sufficient to relieve the wants of a considerable portion of mankind. Indeed, when we consider the fecundity of a single fish, the amount will seem astonishing. If we should be told, for example, that a single being could in one season, produce as many of its kind as there are inhabitants in England, it would strike us with surprise: yet the cod annually spawns, according to Lewenhoeck, above nine million of eggs contained in a single roe. The flounder is commonly known to produce above one million; and the mackerel above five hundred thousand; a herring of a moderate size will yield at least ten thousand: a carp, of fourteen inches in length, contained, according to Petit, two hundred and sixty two thousand two hundred and twenty-four; and another, sixteen inches long, contained three hundred and forty-two thousand one hundred and forty-four; a perch deposited three hundred and eighty thousand six hundred and forty; and a female sturgeon, seven million six hundred and fifty-three thousand two hundred. The viviparous species are by no means so fruitful; yet the blenny brings forth two or three hundred at a time, all alive and playing round the parent together.

PISCES, in astronomy, the twelfth sign or constellation of the zodiac. The stars in Pisces, in Ptolemy's catalogue, are 38; in Tycho's, 33; and in the Britannic catalogue, 109.

PISCIS VOLANS, a small constellation of the southern hemisphere, unknown to the ancients, and invisible to us in these northern regions.

PISOLIT, a mineral found at Carlsbad, in Bohemia. It has the form of round masses composed of concentric layers, and containing a grain of sand in their centre. Colour white, often greyish, reddish, or yellowish.

PISONIA, a genus of the polygamia diœcia class of plants, the corolla whereof is of an infundibuliform shape; the tube is short; the limb is semiquinquefid, acute, and patulous; the fruit is an oval quinquangular capsule, formed of five valves, and containing only one cell; the seed is single, smooth, and oval-oblong. There are five species, trees of the West Indies.

PISTACHIA, *turpentine-tree, pistachia nut, mastich-tree;* a genus of the pentandria order, in the diœcia class of plants. There are six species.

PISTIA, a genus of the monadelphia octandria class and order. There is no calyx; the corolla is one-petalled, tongue-shaped, entire; anthers six or eight; style one; capsule one-celled. There is one species, an aquatic of Senegal.

PISTIL. See *Botany.*

PISTON. See *Pump.*

PISUM, *Pea;* a genus of the decandria order, in the diadelphia class of plants. The style is triangular, above one celled, pubescent; calyx has the two upper segments shorter. The species are, 1. The sativum, or garden-pea. 2. The maritimum, or sea-pea, with footstalks which are plain on their upper side, an angular stalk, arrow-pointed stipulæ, and footstalks bearing many flowers. 3. The ochrus, with membranaceous running footstalks, having two leaves and one flower upon a footstalk.

PITCH, a tenacious oily substance, drawn chiefly from pines and firs, and used in shipping, medicine, and various other arts; or it is more properly tar, inspissated by boiling it over a slow fire. See BITUMEN.

PITCH, *mineral*, has a strong resemblance to common pitch. Colour black, dark brown, or reddish. Specific gravity from 1.45 to 2. Does not stain the fingers. On a white iron it flames with a strong smell, and leaves a quantity of grey ashes. See BITUMEN.

PITCHSTONE. This stone, which occurs in different parts of Germany, France, and other countries, has obtained its name from some resemblance which it has been supposed to have to pitch. It is most usually in amorphous pieces of different sizes.

PITH, in vegetation, the soft spongy substance contained in the central parts of plants and trees.

PLAGUE. Any infectious distemper in foreign countries may be declared the plague, by the king's proclamation. And there are several very salutary regulations by our statute law for the performance of quarantine in order to prevent the extending of infection.

PLAIN *table*, in surveying, a very simple instrument, whereby the draught of a field is taken on the spot, without any future protraction.

PLAN, in general, denotes the representation of something drawn on a plane; such are maps, charts, ichnographies, &c. See MAP, CHART, &c.

The term plan, however, is particularly used

for a draught of a building, such as it appears or is intended to appear, on the ground; shewing the extent, division, and distribution of its area, or ground-plot into apartments, rooms, passages, &c.

PLANE. See GEOMETRY.

PLANE, in joinery, an edged tool, or instrument for paring and shaving of wood smooth. It consists of a piece of wood, very smooth at bottom, as a stock or shaft; in the middle of which is an aperture, through which a steel-edge, or chisel, placed obliquely, passes, which being very sharp, takes off the inequalities of the wood it is slid along. A great improvement in the construction of this instrument has just been made by an ingenious carpenter named Gladwin: it answers all the purposes of the jack-plane, the pannel-plane, the smoothing-plane, and the moulding-plane. For this invention he has been rewarded by the Society of Arts.

PLANET. See ASTRONOMY.

PLANETARIUM, an astronomical machine, made to represent the motions of the planets, and their satellites, as they really are in nature.

PLANISPHERE, signifies a projection of the sphere, and its various circles on a plane; in which sense maps, wherein are exhibited the meridians, and other circles of the sphere, are planispheres.

PLANISPHERE, is more particularly used for an astronomical instrument used in observing the motions of the heavenly bodies. It consists of a projection of the celestial sphere upon a plane, representing the stars, constellations, &c. in their proper order; some being projected on the meridian, and others on the equator.

PLANTING. See AGRICULTURE.

PLASHING *of quickset hedges*, an operation very necessary to promote the growth and continuance of old hedges.

It is performed in this manner: The old stubs must be cut off, &c. within two or three inches of the ground, and the best and longest of the middle-sized shoots must be left to lay down. Some of the strongest of these must also be left to answer the purpose of stakes. These are to be cut off to the height at which the hedge is intended to be left; and they are to stand at ten feet distance one from another: when there are not proper shoots for these at the due distances, their places must be supplied with common stakes of dead wood. The hedge is to be first thinned, by cutting away all those shoots which are intended to be used either as stakes or the other work of the plashing: the ditch is to be cleaned out with the spade; and it must be now dug as at first, with sloping sides each way; and when there is any cavity on the bank on which the hedge grows, or the earth has been washed away from the roots of the shrubs, it is to be made good by facing it, as they express it, with the mould dug from the upper part of the ditch: all the rest of the earth dug out of the ditch is to be laid upon the top of the bank, and the owner should look carefully into it that this is done; for the workmen, to spare themselves trouble, are apt to throw as much as they can upon the face of the bank; which being by this means overloaded, is soon washed off into the ditch again, and a very great part of the work undone; whereas, what is laid on the top of the bank always remains there, and makes a good fence of an indifferent hedge.

PLASTER, in pharmacy, is defined to be an external application, of a harder consistence than our ointments: these are to be spread according to the different circumstances of the wound, place, or patient, either upon linen or leather.

PLASTER OF PARIS. See GYPSUM.

PLATALEA, the *spoonbill*, in ornithology, a genus belonging to the order of grallæ. The beak is plain, and dilates towards the point into an orbicular form; the feet have three toes, and are half-palmated. There are three species, distinguished by their colour: and of these species there are three varieties; two of which are called the white species, and one of the roſeate.

PLATANUS, the *plane-tree*, a genus of the polyandra order, in the monœcia class of plants. The male calyx is an ament, globular; corolla scarcely apparent; anthers growing round the filament. Female calyx ament, globular; corolla many petalled; stigma removed; seeds roundish, marcomate with the style, pappose at the base.

PLATFORM, in the military art, an elevation of earth, on which canon is placed to fire on the enemy; such are the mounts in the middle of curtains. On the ramparts there is always a platform, where the cannon are mounted. It is made by the heaping up of earth on the rampart; or by an arrangement of madriers rising insensibly, for the cannon to roll on, either in a casement or on attack in the outworks. All practitioners are agreed that no shot can be depended on, unless the piece can be placed on a solid platform; for if the platform shakes with the first impulse of the powder, the piece must likewise shake, which will alter its direction, and render the shot uncertain.

PLATINA. See CHEMISTRY.

PLATING, is the art of covering baser metals with a thin plate of silver either for use or for ornament. It is said to have been invented by a spur-maker, not for show but for real utility. Till then the more elegant spurs in common use were made of solid silver; and from the flexibility of that metal, they were liable to be bent into inconvenient forms by the slightest accident. To remedy this defect, a workman at Birmingham contrived to make the branches of a pair of spurs hollow, and to fill that hollow with a slender rod of steel or iron. Finding this a great improvement, and being desirous to add cheapness to utility, he continued to make the hollow larger, and of course the iron thicker and thicker, till at last he discovered the means of coating an iron spur with silver in such a manner as to make it equally elegant with those which were made wholly of that metal. The invention was quickly applied to other purposes; and to numberless utensils which were formerly made of brass or iron are now given the strength of these metals, and the elegance of silver, for a small additional expense.

PLATONIC YEAR, or the GREAT YEAR, is a period of time determined by the revolution of the equinoxes, or the space wherein the stars and constellations return to their former places in respect of the equinoxes. The Pla-

tonic year, according to Tycho Brahe, is 25816: according to Ricciolus 25920; and according to Cassini 24800 years.

PLATOON, in the military art, a small square body of forty or fifty men drawn out of a battalion of foot, and placed between the squadrons of horse, to sustain them; or in ambuscades, straits, and defiles, where there is not room for whole battalions or regiments.

PLATYLOBIUM, a genus of the diadelphia decandria class and order. The calyx is bell-shaped, five-cleft; the two upper segments very large; legume pedicelled, compressed, winged at the back. There is one species a shrub of South Wales.

PLATYPUS, a quadruped of the order of bruta. The generic character is, mouth shaped like the bill of a duck; feet webbed.

PLEA, that which either party alleges for himself in court. These are divided into pleas of the crown and common pleas.

Pleas of the crown are all suits in the king's name against offences committed against his crown and dignity, or against his crown and peace. Common pleas are those that are held between common persons.

Common pleas are either dilatory or pleas to the action.

Pleas dilatory are such as tend merely to delay or put off the suit, by questioning the propriety of the remedy rather than by denying the injury.

Pleas to the action are such as dispute the very cause of suit.

PLEADINGS, in general, signify the allegations of parties to suits when they are put into a proper and legal form; and are distinguished in respect to the parties who plead them by the names of bars, replications, rejoinders, sur-rejoinders, rebutters, sur-rebutters, &c.; and though the matter in the declaration of court does not properly come under the name of pleading, yet, being often comprehended in the extended sense of the word, it is generally considered under this head.

PLEIADES, in astronomy, an assemblage of stars in the neck of the constellation Taurus. See ASTRONOMY.

PLENE ADMINISTRAVIT, a plea pleaded by an executor or administrator, where they have administered the deceased's estate faithfully and justly before the action brought against them.

PLENUM, in physics, denotes, according to the Cartesians, that state of things wherein every part of space is supposed to be full of matter; in opposition to a vacuum.

PLENUS *flos*, in botany, *a full flower*; a term expressive of the highest degree of luxuriance in flowers. The petals in full flowers are so multiplied as to exclude all the stamina, and frequently to choak up the female organ, so that such flowers, though delightful to the eye, are vegetable monsters. Flowers with more than one petal are most liable to this; such are the ranunculus, anemony, poppy, myrtle, &c. &c. Flowers with one petal only are but seldom subject to this fulness; these, however, are not totally exempt, as may be seen in the double polyanthus, hyacinth, crocus, &c. In flowers with one petal, the mode of luxuriance, or impletion is by a multiplication of the divisions of the limb or upper part. In flowers with more than one petal by a multiplication of the petals or nectarium.

PLEURISY, in medicine, a violent pain in the side, attended with an acute fever, a cough, and a difficulty of breathing.

PLEURONECTES, *flounder*, a genus of fishes of the order thoracici, of which there are 17 species. The generic character is, eyes both on the same side of the head; body compressed, one side representing the back, and the other the abdomen.

The singular structure of this genus is justly considered as one of the most curious deviations from the general uniformity or regularity observed by nature in the external figure of animals, in which (except in a very few instances) both sides of the body are perfectly similar; but in the genus pleuronectes the animal is so constituted, that one side appears to represent the back, and the opposite side the abdomen. They swim laterally, and the eyes are always placed on one side. It is from this circumstance that the division of the species is conducted, viz. into those which have the eyes dextrous, or towards the right, when the fish is laid with its coloured side upwards with its abdomen towards the spectator; and sinistrous when the eyes are towards the left in the above situation of the fish.

PLOT, in dramatic poetry, is sometimes used for the fable of a tragedy or comedy, but more particularly the knot of intrigue, which makes the embarras of any piece. The unravelling puts an end to the plot.

PLOT, in surveying, the plan or draught of any field, farm, or manor surveyed with an instrument, and laid down in the proper figure and dimensions.

PLOTTING, among surveyors, is the art of laying down on paper, &c. the several angles and lines of a tract of ground surveyed by a theodolite, &c. and a chain. In surveying with the plain table, the plotting is saved; the several angles and distances being laid down on the spot, as fast as they are taken.

PLOUGH, in agriculture, a machine for turning up the soil, contrived to save the time, labour, and expence, that without this instrument must have been employed in digging land, to prepare it for the sowing of all kinds of grain. See AGRICULTURE.

PLOUGH, among bookbinders, is a machine for cutting the edges of the leaves of books smooth.

PLUM-*tree*. See PRUNUS.

PLUMB-*line*, among artificers, denotes a perpendicular to the horizon; so called as being commonly erected by means of a plummet.

PLUMBERY is the art of casting and working lead, and using it in the various departments of life, as buildings pipes &c.

PLUMMET, plumb-rule, or plumb-line, an instrument used by carpenters, masons, &c. in order to judge whether walls, &c. are upright planes, horizontal, or the like. It is thus called from a piece of lead, fastened to the end of a cord, which usually constitutes this instrument. Sometimes the string descends along a wooden ruler, &c. raised perpendicularly on another, in which case it becomes a level.

PLUMMING, among miners, is the method of using a mine dial, in order to know

the exact place of the work where to sink down an air shaft, or to bring in an adit to the work, or to know which way the load inclines when any flexure happens in it.

PLUS, in algebra, a character marked thus +, used for the sign of addition. See Algebra.

PLUSH, in commerce, &c a kind of stuff leaving a sort of velvet knap, or shag, on one side, composed regularly of a woof of a single woollen thread, and a double warp, the one wool, of two threads twisted, the other goats' or camels' hair; though there are some plushes entirely of worsted, and others composed wholly of hair.

PNEUMATICS. This term is derived from the Greek *πνευμα, a spirit*, and is used to designate that science which treats of the mechanical properties of air, and other compressible fluids.

The air is a fluid in which we live and breathe; it entirely envelopes our globe, and extends to a considerable height around it. Together with the clouds and vapours that float in it, it is called the atmosphere. As it is possessed of gravity in common with all other fluids, it must press upon bodies in proportion to the depth at which they are immersed in it; and it also presses in every direction, in common with all other fluids.

It differs from all other fluids in the four following particulars: 1. It can be compressed into a much less space than it naturally possesses; 2. It cannot be congealed or fixed as other fluids may; 3. It is of a different density in every part upward from the earth's surface; decreasing in its weight, bulk for bulk, the higher it rises; 4. It is of an elastic or springy nature, and the force of its spring is equal to its weight.

When the air is at rest, we can move in it with the utmost facility; nor does it offer to us a sensible resistance, except the motion is quick, or the surface opposed to it considerable; but when that is the case, its resistance is very sensible, as may be easily perceived by the motion of a fan.

When air is in motion, it constitutes wind; which is nothing more than a current or stream of air, varying, in its force, according to the velocity with which it flows.

The invisibility of air, therefore, is only the consequence of its transparency; but it is possessed of all the common properties of matter. When a vessel is empty, in the usual way of speaking, it is, in fact, still filled with air.

But it is possible to empty a vessel even of the air which it contains, by which means we shall be able to discover several properties of this fluid. The instrument, or machine, by which this operation is performed, is called an air-pump. As it is by means of this useful instrument that all the mechanical properties of air are demonstrated, it will be necessary to describe its construction, and the manner of using it, before we proceed to the experiments that are made with it.

Plate XLV, fig. 1, is the air-pump that is now most in use. A A are two brass barrels, each containing a piston, with a valve opening upwards. They are worked by means of the winch B, which has a pinion that fits into the teeth of the racks C C, which are made upon the ends of the pistons, and by this means moves them up and down alternately.

On the square wooden frame D E, there are placed a brass plate G, ground perfectly flat, and also a brass tube, let into the wood, communicating with the two barrels and the cock I, and opening into the centre of the brass plate at *a*. The glass vessel K, to be emptied or exhausted of air, has its rim ground quite flat, and rubbed with a little pomatum, or hogs' lard, to make it fit more closely upon the brass plate of the pump. These vessels are called receivers. Having shut the cock I, the pistons are worked by the winch; and the air being suffered to escape when the piston is forced down, because the valve opens upwards, but prevented from returning into the vessel for the same reason, the receiver is gradually exhausted, and will then be fixed fast upon the pump-plate. By opening the cock I, the air rushes again into the receiver.

Of the Pressure of the Air.

When the surface of a fluid is exposed to the air, it is pressed by the weight of the atmosphere equally on every part, and consequently remains at rest. But if the pressure is removed from any particular part, the fluid must yield in that part, and be forced out of its situation.

Into the receiver A, fig. 2, put a small vessel with quicksilver *z*, or any other fluid, and through the collar of leathers at B, suspend a glass tube *x*, closed, or hermetically sealed, as it is called, over the small vessel. Having exhausted the receiver, let down the tube into the quicksilver, which will not rise into the tube as long as the receiver continues empty. But re-admit the air, and the quicksilver will immediately ascend. The reason of this is, that upon exhausting the receiver, the tube is likewise emptied of air; and therefore, when it is immersed in the quicksilver, and the air re-admitted into the receiver, all the surface of the quicksilver is pressed upon by the air, except that portion which lies above the orifice of the tube; consequently, it must rise in the tube, and continue so to do, until the weight of the elevated quicksilver presses as forcibly on that portion which lies beneath the tube, as the weight of the air does on every other equal portion without the tube.

A square column of quicksilver twenty-nine and a half inches high, and an inch thick, weighs just fifteen pounds, consequently, the air presses with a weight equal to fifteen pounds upon every square inch of the earth's surface: and 144 times as much, or 2160 pounds, upon every square foot.

The pressure of the air is beautifully illustrated by what are called the Magdiburgh hemispheres. These are represented by fig. 3, and consist of two hollow hemispheres of brass, which are made to fit upon each other by a ground joint rendered air-tight by a little pomatum. Having screwed off the handle at C, put both the hemispheres together, and screw them into the pump-plate, and turn the cock E, so that the pipe may be open all the way into the cavity of the hemispheres; then exhaust the air out of them, and turn the cock; unscrew the hemispheres from the pump, and having put on the handle C, let two strong

men try to pull the hemispheres asunder by the rings, which they will find hard to do; for if the diameter of the hemispheres is four inches, they will be pressed together by the external air with a force equal to 190 pounds.

Screw the end A of the brass pipe AB, fig. 4, into the pump-plate, and turn the cock *e* until the pipe is open; then put a wet leather on the plate *ca*, fixed on the pipe, and cover it with the tall receiver GH, which is close at top; then exhaust the air out of the receiver, and turn the cock *e* to keep it out; which done, unscrew the pipe from the pump, and set its end A into a bason of water, and turn the cock *e* to open the pipe; on which, as there is no air in the receiver, the pressure of the atmosphere on the water in the bason will drive the water forcibly through the pipe, and make it play up in a jet to the top of the receiver.

Of the Elasticity of the Air.

To shew the elasticity or spring of the air, tie up a very small quantity of air in a bladder, and put it under the receiver; then exhaust the air out of the receiver, and the air which is confined in the bladder (having nothing to act against it) will expand by the force of its spring, so as to fill the bladder completely. But upon letting the air into the receiver again, it will overpower that in the bladder, and press its sides close together.

If the bladder so tied up is put into a wooden box, and has twenty or thirty pounds weight of lead placed upon it, and the box is covered with a close receiver; upon exhausting the air out of the receiver, that which is confined in the bladder will expand itself so as to raise up all the lead by the force of its spring.

A very pleasing variety of this experiment is exhibited by lecturers with what is called the condensed air-fountain. Take a strong copper vessel, fig. 5, having a tube that screws into the neck of it so as to be air tight, and long enough to reach nearly to the bottom. Having poured a quantity of water into the vessel, so as to fill it about three parts full, and screwed in the tube, adapt to it a condensing syringe, and condense the air in the vessel; shut the stop-cock, and unscrew the syringe; then, on opening the stop-cock, the air acting upon the water in the vessel, will force it out into a jet of very great height. A number of different kinds of jets may be screwed on the tube, such as stars, wheels, &c. forming a very pleasing appearance.

But the most striking pneumatic experiment for shewing the elasticity of compressed air, is the air-gun. By means of this instrument, bullets may be propelled with a force nearly equal to that of gun-powder.

Fig. 6 represents the condenser for forcing the air into the ball. At the end *a* of this instrument is a male screw, on which the hollow ball *b* is screwed, in order to be filled with condensed air. In the inside of this ball is a valve, to hinder the air after it is injected from making its escape, until it is forced open by a pin, against which the hammer of the lock strikes; which then lets out as much air as will drive a ball with considerable force to a great distance.

When you condense the air in the ball, place your feet on the iron cross *hh*, to which the piston-rod *d* is fixed; then lift up the barrel *ea*, by the handles *ii*, until the end of the piston is brought between *e* and *c*: the barrel *ac* will then be filled with air through the whole *e*. Then thrust down the barrel *ac* by the handles *ii*, until the piston *e* joins with the neck of the iron ball at *a*: the air, being thus condensed between *e* and *a*, will force open the valve in the ball; and when the handles *ii* are lifted up again, the valve will close, and keep in the air; so by rapidly continuing the stroke up and down, the ball will presently be filled; after which, unscrew the ball off the condenser, and screw it upon another male screw, which is connected with the barrel, and goes through the stock of the gun, as represented fig. 7. Twelve dwts. of air have been injected into a ball of 3.75 inches diameter, which has discharged 15 bullets with considerable force.

It may be expected that we should here give some account of the old magazine air-gun, but we deem that altogether unnecessary, as the modern make of the instrument is far superior, and universally adopted. And, indeed, all the advantages of that clumsy article are combined with the lightest form in which the air-gun is at present made.

Before quitting this article we would just notice, that, although we have given a drawing of the common table pump, it is an article of which we by no means approve, if the experiments are such as require great nicety and quickness of exhaustion.

Cuthbertson's double barrelled pump, which stands table height, is at once the most elegant and powerful instrument that can be used for pneumatical purposes.

In many pneumatic experiments it is required to effect strong condensations of air, and sometimes of gases. For this purpose an instrument, called a condenser, represented at fig. 8, is used. It consists of a brass barrel containing a piston, which has a valve opening downwards; so that as the piston is raised, the air passes through the valve; but as the piston is pushed down, the air cannot return, and is therefore forced through a valve at the bottom of the barrel, that allows it to pass through into the receiver B, but prevents it from returning. Thus, at every stroke of the piston, more air is thrown into the receiver, which is of very thick and strong glass. The receiver is held down upon the plate C by the cross piece D, and the screws EF. The air is let out of the receiver by the cock G, which communicates with it.

POCKET, in the woollen trade, a word used to denote a larger sort of bag, in which wool is packed up to be sent from one part of the kingdom to another. The pocket contains usually twenty-five hundred weight of wool. The pocket of hops is also a small bag usually containing the best hops.

POETRY, or POESY, is a term derived from the Greek ποιητρια, ποιησις, of ποιεω, *I make*, and is used to designate that particular kind of literary composition which is characterized by metrical harmony. *Dr. Blackwall*, in his "Essay on the Life and Writings of Homer," says, on the subject of poetry, that "it is of a nature so delicate, as not to admit of a direct definition; for if ever the *je ne scais quoi* was rightly applied, it is to the

powers of poetry, and the faculty that produces it. To go about to describe it would be like attempting to define inspiration, or that glow of fancy, or effusion of soul, which a poet feels while in his fit; a sensation so strong, that they express it only by abjurings, exclamations, and rapture." To the same purpose, but in less inflated language, Dr. Blair has observed, that it is not so easy as might at first be imagined to ascertain with minute precision wherein poetry differs from prose. In point of fact, every reflecting reader must be sensible, that as it is difficult to determine the precise line where different shades of colour terminate, or even the boundaries of animal and vegetable nature, so it is a matter of no small nicety to fix the point where composition rises from the scale of prose to that of poetry.

By a small addition to the ideas of Aristotle, poetry may, however, be defined an imitative and creative art, whose energies are exerted by means of words metrically arranged, the end and design of which art is to amuse the fancy, and powerfully to excite the feelings.

The word poet, in its original import, signifies creator. And as names are not unfrequently significant of the nature of the ideas which they represent, the name itself of poetry will direct us to one of its most distinguishing characteristics. It is, indeed, one of the noblest qualities of poetry, that it opens to the mind a new creation.

"The poet's eye, in a fine frenzy rolling,
Doth glance from heaven to earth, from earth to heaven:
And as imagination bodies forth
The form of things unknown, the poet's pen
Turns them to shapes, and gives to airy nothing
A local habitation and a name."

But though melodious and metrical arrangement of words be one of the characteristics, and, as Dr. Blair denominates it, "the exterior distinction" of poetry, it is necessary to observe, that too many writers seem to assign to this characteristic a place of eminence to which it is by no means entitled. In consequence of this error, vast multitudes of compositions are obtruded upon the world under the name of poems, which possess no other merit than that of regularity of versification and smoothness of numbers. Against these wearisome productions, Horace has long ago protested in his memorable declaration, that the quality of mediocrity is denied to poets, and that poetry includes something more in its definition than the measuring of syllables and the tagging of a verse. If the heart does not glow with the flame of genius, the mechanism of art will be of no avail.

He who aspires after the title of poet should never, indeed, forget, that the end of poetry is to amuse the fancy and powerfully to excite the feelings, and that this is effected by impressing the mind with the most vivid pictures. In the course of her operations, poetry hurries us beyond the reach of sober judgment, and captivates by rousing the energy of passion. Here then we see the cause of the power of verse, nor wonder at the efficaciousness which has, more especially in early times, been ascribed to the muses. For how easily are mankind guided by those who possess the art of awakening or of allaying their feelings. Though all unconscious of being under the guidance of another, they turn obedient to the rein. They are roused to insurrection, or moderated to peace, by him who can touch with a skilful hand the master springs that regulate the motion of their minds. "The primary aim of a poet," says Dr. Blair, "is to please and to move; and therefore it is to the imagination and the passions that he speaks. He may, and he ought to have it in his view, to instruct and to reform; but it is indirectly, and by pleasing and moving that he accomplishes this end. His mind is supposed to be animated by some interesting object, which fires his imagination, or engages his passions; and which of course communicates to his style a peculiar elevation, suited to his ideas, very different from that mode of expression which is natural to the mind in its calm ordinary state."

POINT, in geometry, as defined by Euclid, is a quantity which has no parts, or which is indivisible. Points are the ends or extremities of lines. If a point be supposed to be moved any way, it will, by its motion, describe a line.

POINTS, in heraldry, are the several different parts of an escutcheon, denoting the local positions of any figure. See HERALDRY.

POINT is also an iron or steel instrument, used with some variety in several arts. Engravers, etchers, cutters in wood, &c. use points to trace their designs on the copper, wood, stone, &c. See ENGRAVING, &c.

POINT, in the manufactories, is a general term, used for all kinds of laces wrought with the needle; such are the point de Venice, point de France, point de Genoa, &c., which are distinguished by the particular economy and arrangement of their points.

POINT-BLANK, in gunnery, denotes the shot of a gun levelled horizontally.

POISONS. Substances which, when applied to living bodies, derange the vital functions, and produce death, by an action not mechanical. The study of their nature, mode of operation, and antidotes, has been called *toxicology.*

Antidotes for poisons have often proved effectual, but in most cases they completely fail; and on this account, the surgeon, who now applies the most powerful of them, may be considered as trifling with the life of his patient, if he neglect the immediate use of the stomach pump, lately invented by Mr. Jukes, by means of which the contents of the stomach may be instantly withdrawn.

POLARITY, the quality of a thing considered as having poles; but chiefly used in speaking of the magnet. See MAGNETISM.

POLARIZATION OF LIGHT. This new branch of optical science sprung from the ingenuity of Malus. It has been since cultivated by M.M. Arago, Fresnel, and Biot, in France, and by Dr. Brewster, in this country.

An excellent article on the subject has appeared in the supplement to the Encyclopædia Britannica, by M.M. Arago.

If a solar ray fall on the anterior surface of an unsilvered mirror plate, making an angle with it of 35° 25′, the ray will be reflected in a right line, so that the angle of reflection will be equal to the angle of incidence. In any point of its reflected path, receive it on

another plane of similar glass, it will suffer in general a second partial reflection. But this reflection will vanish, or become null, if the second plate of glass form an angle of 35° 25′ with the first reflected ray, and at the same time be turned, so that the second reflection is made in a plane perpendicular to that in which the first reflection takes place. For the sake of illustration: suppose that the plane of incidence of the ray on the first glass coincides with the plane of the meridian, and that the reflected ray is vertical. Then, if we make the second inclined plate revolve, it will turn around the reflected ray, forming always with it the same angle; and the plane in which the second reflection takes place will necessarily be directed towards the different points of the horizon, in different azimuths. This being arranged, the following phenomena will be observed.

When the second plane of reflection is directed in the meridian, and consequently coincides with the first, the intensity of the light reflected by the second glass is at its maximum.

In proportion as the second plane, in its revolution, deviates from its parallelism with the first, the intensity of the reflected light will diminish.

Finally, when the second plane of reflection is placed in the prime vertical, that is, east and west, and consequently perpendicular to the first, the intensity of the reflection of light is absolutely null on the two surfaces of the second glass, and the ray is entirely transmitted.

Preserving the second plate at the same inclination to the horizon, if we continue to make it revolve beyond the quadrant now described, the phenomena will be reproduced in the inverse order; that is, the intensity of the light will increase, precisely as it diminished, and it will become equal, at equal distances from the east and west. Hence, when the second plane of reflection returns once more to the meridian, a second maximum of intensity equal to the first recurs.

From these experiments it appears, that the ray reflected by the first glass, is not reflected by the second, under this incidence, when it is presented to it by its east and west sides; but that it is reflected, at least in part, when it is presented to the glass by any two others of its opposite sides. Now, if we regard the ray as an infinitely rapid succession of a series of luminous particles, the faces of the ray are merely the successive faces of these particles. We must hence conclude, that these particles possess faces endowed with different physical properties, and that in the present circumstance, the first reflection has turned towards the same sides of space similar faces, or faces equally endowed at least with the property under consideration. It is this arrangement of its molecules which Malus named the *polarization* of light, assimilating the effect of the first glass to that of a magnetic bar, which would turn a series of magnetic needles, all in the same direction.

Hitherto we have supposed that the ray, whether incident or reflected, formed with the two mirror plates an angle of 35° 25′; for it is only under this angle that the phenomenon is complete. Without changing the inclination of the ray to the first plate, if we vary ever so little the inclination of the second, the intensity of the reflected light is no longer null in any azimuth, but it becomes the feeblest possible in the prime vertical in which it was formerly null.

Similar phenomena may be produced, by substituting for the mirror glasses polished plates formed for the greater part of transparent bodies. The two planes of reflection must always remain rectangular, but they must be presented to the luminous ray at different angles, according to their nature. Generally, all polished surfaces have the property of thus polarizing, more or less completely, the light which they reflect under certain incidences; but there is for each of them a particular incidence, in which the polarization it impresses is most complete; and for a great many, it amounts to the whole of the reflected light.

When a ray of light has received polarization in a certain direction, by the processes now described, it carries with it this property into space, preserving it without preceptible alteration, when we make it traverse perpendicularly a considerable mass of air, water, or any substance possessed of single refraction. But the substances which exercise double refraction. in general alter the polarization of the ray, and apparently in a sudden manner, and communicate to it a new polarization of the same nature, but in another direction. It is only in certain directions of the principal section, that the ray can escape this disturbing force.

POLE, in astronomy, one of the extremities of the axis, on which the sphere revolves. These two points, each ninety degrees distant from the equinoctial or equator, are by way of eminence called the poles of the world; and the extremities of the axis of the artificial globes, corresponding to these points in the heavens, are termed the poles thereof.

Pole, Perch, or **Rod**, in surveying, is a measure containing sixteen feet and a half.

Pole, or **Polar** *star*, is a star of the second magnitude, the last in the tail of ursa minor. Its longitude Mr. Flamsteed makes 24° 14′ 41″; its latitude, 66° 4′ 11″.

Pole-cat. See Viverra.

POLEMONIUM, *Greek valerian*, or *Jacob's ladder*: a genus of the monogynia order in the pentandria class of plants; and in the natural method ranking under the 29th order, campanaceæ. There are five species, of which the most remarkable is the cæruleum, with an empalement longer than the flower. It grows naturally in some places of England: its beauty, however, has obtained it a place in the gardens.

POLICY of ASSURANCE. The deed or instrument by which a contract of assurance is effected. The premium or consideration paid for the risk or hazard assured against, must be inserted in the policy, and likewise the day, month, and year, on which the policy is executed, and it must be duly stamped.

POLL, a word used in ancient writings for the head: hence to poll is either to vote or to enter down the names of those persons who give in their votes at an election.

Poll-money, a capitation or tax imposed by the authority of parliament on the head or person either of all indifferently, or according to some known mark of distinction.

POLLIA, a genus of the class and order hexandria monogynia. The corolla is infe

rior, six-petalled; berry many-seeded. There is one species, an herbaceous plant of Japan.

POLLICHIA, a genus of the monandria monogynia class and order. The calyx is one-leafed, five-toothed; corolla, five petals; seed solitary; receptacle succulent, aggregate scales. There is one species, of the Cape.

POLLUX, in astronomy, a fixed star of the second magnitude in the constellation Gemini or the Twins. See ASTRONOMY.

POLYADELPHIA (from ϖολυς *many*, and αδελφια, *brotherhood*,) many brotherhoods; the name of the 18th class of Linnæus's sexual system, consisting of plants with hermaphrodite flowers in which several stamina or male organs are united by their filaments into three or more distinct bundles.

POLYANDRIA (from ϖολυς, many, and ανερ, a *man* or *husband*,) many husbands; the name of the 13th class in Linnæus's sexual method, consisting of plants with hermaphrodite flowers, which are furnished with several stamina that are inserted into the common receptacle of the flower.

POLYGAMIA (πολυς, *many*, and γαμος, *marriage*). This term, expressing an intercommunication of sexes, is applied, by Linnæus, both to plants and flowers. A polygamous plant is that which bears both hermaphrodite flowers and male or female, or both.

POLYGAMY, a plurality of wives or husbands, in the possession of one man or woman, at the same time; which by the laws of England is felony.

POLYGLOTT, among divines and critics, chiefly denotes a bible printed in several languages. In these editions of the holy scriptures, the text in each language is ranged in opposite columns.

POLYGON. See GEOMETRY.

POLYGONAL NUMBERS, are so called because the units whereof they consist may be disposed in such a manner as to represent several regular polygons.

POLYNEMUS, *polyneme*, a genus of fishes of the order abdominales. The generic character, is head repressed, covered with scales; snout very obtuse and prominent; gill, membrane five or seven rayed; separate filaments or setaceous processes near the base of the pectoral fins.

POLYPUS, the popular name for those fresh-water insects, which class under the genus of hydra, of the order of vermes zoophytæ. The name of hydra was given them by Linnæus on account of the property they have of reproducing themselves when cut in pieces, every part soon becoming a perfect animal.

PONTON or PONTOON, in war, denotes a little floating-bridge made of boats and planks. The ponton is a machine consisting of two vessels, at a little distance, joined by beams, with planks laid across for the passage of the cavalry, the cannon, infantry, &c. over a river, or an arm of the sea, &c.

POOR-LAWS, the term is applied to those regulations adopted by the country, for the support of all those who are in such a low and mean condition, that they either are, or may become a burden to the parish.

POOR'S-RATE, an assessment raised throughout England and Wales, for the temporary relief, or permanent maintenance, of all such persons, as from age, infirmity, or poverty; cannot themselves procure the means of subsistence.

POPE, PAPA, FATHER, the sovereign pontiff, or supreme head of the Romish church. The appellation of pope was anciently given to all christian bishops: but about the latter end of the eleventh century it was discontinued.

POPULATION, the state of a country with respect to the number of its inhabitants.

The obvious principle, that population is necessarily limited by the means of subsistence has been stated, and conclusions drawn from it, by many different writers; but it has lately been discussed at great length in an "Essay on the Principle of Population," by Mr. T. R. Malthus, who has endeavoured to prove that population invariably increases where the means of subsistence increase, unless prevented by some very powerful and obvious checks; and that these checks, and the checks which repress the superior power of population, and keep its effects on a level with the means of subsistence, are all resolvable into moral restraint, vice, and misery. Under whatever denomination the causes which adjust population to the circumstances of the country may be classed, it is certain that they exist in every civilized country, and while the nature of men remains the same they must continue to exist, although operating in a greater or less degree according to the progress the country has made in cultivation, commerce, and political power.

POPULUS, the POPLAR, a genus of the octandria order, in the diœcia class of plants; and in the natural method ranking under the 50th order, amentaceæ. The calyx of the amentum is a lacerated, oblong, and squamous leaf; the corolla is turbinated, oblique, and entire. The female has the calyx of the amentum and corolla the same as in the male; the stigma is quadrifid; the capsule bilocular, with many pappous seeds. There are eleven species.

PORCELAIN is the most beautiful and the finest of all earthen wares.

The art of making porcelain is one of those in which Europe has been excelled by oriental nations. The first porcelain that was seen in Europe was brought from Japan and China. The whiteness, transparency, fineness, neatness, elegance, and even the magnificence of this pottery, which soon became the ornament of sumptuous tables, did not fail to excite the admiration and industry of Europeans.

Father Entrecolles, missionary at China, sent home a summary description of the process by which the inhabitants of that country make their porcelain, and also a small quantity of the materials which they employ in its composition. He said, that the Chinese compose their porcelain of two ingredients, one of which is a hard stone or rock, called by them petuntse, which they carefully grind to a very fine powder; and the other, called, by them kaolin, is a white earthy substance which they mix intimately with the ground petuntse.

Reaumur examined both these matters; and having exposed them separately to a violent fire, he discovered that the petuntse had

fused without addition, and that the kaolin had given no sign of fusibility. He afterward mixed these matters, and formed cakes of them, which, by baking, were converted into porcelain similar to that of China.

Reaumur gave the quality of porcelain to glass; that is, he rendered glass of a milky colour, semi-transparent, so hard as to strike fire with steel, infusible, and of a fibrous grain, by means of cementation. The process, which he published, is not difficult. Common glass, such as that of which wine bottles are made, succeeds best. The glass vessel which is to be converted into porcelain, is to be enclosed in a baker's earthen case or seggar. The vessel and case are to be filled with a cement composed of equal parts of sand and powdered gypsum or plaster; and the whole is to be put into a potter's kiln, and to remain there during the baking of common earthenware; after which the glass vessel will be found transformed into such a matter as has been described.

PORCUPINE. See Hystrix.

PORE, in anatomy a little interstice or space between the parts of the skin, serving for perspiration. See Cutis, and Physiology.

Pores, are the small interstices between the particles of matter which compose bodies; and are either empty, or filled with some insensible medium.

Condensation and rarefaction are only performed by closing and opening the pores.

PORPHYRY is a compound rock, having a basis, in which the other contemporaneous constituent parts are imbedded. The base is sometimes clay-stone, sometimes hornstone, sometimes compact felspar; or pitchstone, pearlstone, and obsidian. The imbedded parts are most commonly felspar and quartz, which are usually crystallized more or less perfectly, and hence they appear sometimes granular. According to Werner, there are two distinct porphyry formations; the oldest occurs in gneiss, in beds of great magnitude; and also in mica-slate and clay-slate. Between Blair in Athole and Dalnacardoch, there is a very nple of a bed of porphyry-slate in The second porphyry formation is much more widely extended. It consists principally of clay porphyry, while the former consists chiefly of hornstone porphyry and felspar porphyry.

PORT, a harbour or place of shelter, where ships arrive with their freight, and customs from goods are taken.

Port-holes, in a ship, are the holes in the sides of the vessel, through which are put the muzzles of the great guns. These are shut up in storms to prevent the water from driving through them

PORTCULLIS, in fortification, is an assemblage of several large pieces of wood, joined across one another like a harrow, and each pointed with iron at the bottom. They are sometimes hung over the gateway of old fortified towns, ready to let down in case of surprise, when the gates could not be shut.

PORTER, a kind of malt liquor, which differs from ale and pale beer in its being made with high dried malt.

PORTGREVE, or portgrave, anciently the principal magistrate in ports and other maritime towns. The word is formed from the Saxon "port," and "geref," a governor. It is sometimes also written "portreve." It it said by Camden, that the chief magistrate of London was anciently called portgreve, which was exchanged by Richard I. for two bailiffs; and these again gave place, in the reign of king John, to a mayor, who was an annually elected magistrate.

PORTICO, in architecture, a kind of gallery on the ground, supported by columns, where people walk under covert.

PORTLAND-STONE, is a dull whitish species of stone, much used in buildings; it is composed of a coarse grit, cemented together by an earthy spar: it will not strike fire with steel, but makes a violent effervescence with nitric acid.

PORTRAIT. See Painting.

POSITION, or the *rule of false* Position, otherwise called the *rule of* Falsehood, in arithmetic, is a rule so called, because in calculating on several false numbers taken at random, as if they were the true ones, and from the differences found therein, the number sought is determined. This rule is either single or double. Single position is when there happens in the proposition some partition of numbers into parts proportional, in which case the question may be resolved, at one operation, by this rule. Imagine a number at pleasure, and work therewith according to the tenor of the question, as if it were the true number: and what proportion there is between the false conclusion and the false proportion, such proportion the given number has to the number sought. Therefore the number found by argumentation shall be the first term of the rule of three: the second number supposed, the second term; and the given number, the third. Or the result is to be regulated by this proportion, *viz.* As the total arising from the error to the true total, so is the supposed part to the true one. Example, A, B, and C, designing to buy a quantity of lead to the value of 140*l.* agree that B shall pay as much again as A, and C as much again as B; what then must each pay.

Now suppose A to pay 10*l.* then B must pay 20*l.* and C 40*l.* the total of which is 70*l.* but should be 140*l.* Therefore, if 70*l.* should be 140*l.* what should 10*l.* be?

Answer, 20*l.* for A's share, which doubled makes 40*l.* for B's share, and that again doubled gives 80*l.* for C's share, the total of which is 140*l.* Double position is when there can be no partition in the numbers to make a proportion. In this case, therefore, you must make a supposition twice, proceeding therein according to the tenor of the question. If neither of the supposed numbers solve the proportion, observe the errors, and whether they be greater or less than the supposition requires, and mark the errors accordingly with the sign × and —.

Then multiply contrarywise the one position by the other error, and if the errors be both too great, or both too little, subtract the one product from the other, and divide the difference of the errors. If the errors be unlike, as the one + and the other —, add the products, and divide the sum thereof by the sum of the errors added together: for the proportion of the errors is the same with the proportion of the excesses or defects of the numbers supposed to be the number sought: or the sup-

positions and their errors being placed as before, work by this proportion as a general rule, viz. as the difference of the errors, if alike, or their sum, if unlike, is to the difference of the suppositions, so either error to a fourth number, which accordingly, added to or subtracted from the supposition against it, will answer the question.

POSSESSION, is two-fold, actual and in law. Actual possession is when a man actually enters into lands and tenements to him descended. Possession in law, is when the lands or tenements are descended to a man, and he has not as yet actually entered into them.

POST, a military station. Thus the detachments established in front of. the army are termed out-posts; the stations on the wings of the army are said to be the posts of honour, as being the most conspicuous and most exposed. But in the operations of a campaign, a post properly signifies any spot of ground capable of lodging soldiers, or any situation, whether fortified or not, where a body of men may make a stand, and engage the enemy to advantage. The great advantages of good posts, in carrying on war, as well as the mode of securing them, are only learned by experience.

Post, a conveyance for letters or dispatches.

The present establishment of the general post-office of Great Britain, consists of a post-master-general, to the duties of which station there have, for many years past been two persons appointed, under the title of joint post-masters-general; a secretary; upwards of 150 assistants and clerks for the head letter-office in London, under the direction of a superintending president of the inland-letter department; and a comptroller of the foreign-letter office. Near 600 deputy-postmasters throughout the kingdom, act under one principal, and nine riding surveyors. There are also distinct officers and clerks, acting under an accountant-general and a receiver-general; as well as a separate establishment for the two-penny, formerly the penny-post, which since the abolition of Mr. Palmer's appointment of surveyor and comptroller-general, has been new modelled and greatly improved in all its branches. There is likewise a post-master-general of Scotland with a secretary, comptroller, surveyor, and a separate establishment of all the requisite officers and clerks at Edinburgh, acting under the orders of the joint postmasters-general in London. The annual expence of management is about 350,000*l.* and the gross produce exceeds 1,300,000*l.* a year.

POST, *two-penny*, a post established for the benefit of London and other parts adjacent, whereby any letter or small parcel is speedily and safely conveyed to and from all places within the bills of mortality, or within ten miles of the city. It is now managed by the general post office, and receiving-houses are established in most of the principal streets for the more convenient transmission of letters.

POST, a particular mode of travelling. A person is said to travel post, in contradistinction to common journey travelling, when in place of going on during his whole journey in the same vehicle, and with the same horses, he stops at different stages, to provide fresh horses, or carriages, for the sake of greater convenience and expedition. As he thus uses the same mode of travelling that is employed for the common post, he is said to travel post, or in post, i. e. in the manner of a post.

POST DISSEISIN, a writ for him that having recovered land or tenements by præcipe quod reddat, upon default of reddition, is again disseised by the former disseisor.

POSTEA, is the return of the proceedings by nisi prius into the court of common pleas after a verdict, and there afterwards recorded.

POSTERN, in fortification, is a small gate generally made in the angle of the flank of a bastion, or in that of the curtain, or near the orillon, descending into the ditch; by which the garrison may march in and out unperceived by the enemy, either to relieve the works, or to make private sallies, &c.

POSTULATE, in mathematics, &c. is described to be such an easy, and self-evident supposition, as needs no explication or illustration to render it intelligible; as, that a right line may be drawn from one point to another.

POTASH, commonly called the vegetable alkali, because it is obtained in an impure state by the incineration of vegetables. It is the hydrated protoxide of potassium.

Table of the saline product of one thousand pounds of ashes of the following vegetables

Saline products.

Stalks of Turkey wheat or maize, 198 lbs. Stalks of sun-flower, 349. Vine branches, 162.6. Elm, 166. Box, 78. Sallow, 102. Oak, 111. Aspen, 61. Beech, 219. Fir, 132. Fern cut in August, 116, or 125, according to Wildenheim. Wormwood, 748. Fumitory, 360. Heath, 115, Wildenheim.

On these tables Kirwan makes the following remarks:—

1. That in general weeds yield more ashes, and their ashes much more salt, than woods; and that consequently, as to salts of the vegetable alkali kind, as potash, pearl-ash, cashup, &c. neither America, Trieste, nor the northern countries, have any advantage over Ireland.

2. That of all weeds fumitory produces most salt, and next to it wormwood. But if we attend only to the quantity of salt in a given weight of ashes, the ashes of wormwood contain most. Trifolium fibrinum also produces more ashes and salt than fern.

The process for obtaining pot and pearl-ash is given by Kirwan, as follows:—

1. The weeds should be cut just before they seed, then spread, well dried, and gathered clean.

2. They should be burned within doors on a grate, and the ashes laid in a chest as fast as they are produced. If any charcoal be visible, it should be picked out, and thrown back into the fire. If the weeds be moist, much coal will be found. A close smothered fire, which has been recommended by some is very prejudicial.

3. They should be lixiviated with twelve times their weight of boiling water. A drop of the solution of corrosive sublimate will immediately discover when the water ceases to take up any more alkali. The earthy matter that remains is said to be a good manure for clayey soils.

4. The ley thus formed should be evaporated to dryness in iron pans. Two or three at least of these should be used, and the ley, as fast as it is concreted, passed from the one to the other. Thus, much time, is saved, as weak leys eva-

porate more quickly than the stronger The salt thus produced is of a dark colour, and contains much extractive matter, and being formed in iron pots is called potash.

5. This salt should then be carried to a reverberatory furnace, in which the extractive matter is burnt off, and much of the water dissipated: hence it generally loses from ten to fifteen per cent. of its weight. Particular care should be taken to prevent its melting, as the extractive matter would not then be perfectly consumed, and the alkali would form such a union with the earthy parts as could not easily be dissolved.

POTASSIUM. See Chemistry.

POTATOE. See Solanum.

POTTERY, the manufacture of earthen ware, or the art of making earthen vessels. The inferior kinds of porcelain, or pottery, are prepared by the same process as that which has been described under the word Porcelain, less pure, but more fusible materials being employed, and of course a less degree of heat being applied.

The better kinds of English stone-ware are composed of pipe-clay, and pounded flints. The yellow stone-ware is made of the same materials, in other proportions. The first is glazed by throwing sea-salt into the furnace in which it is baked, when the heat is strong; the salt is converted into vapour, and this, being applied to the surface of the stone-ware, vitrifies it, and forms an excellent glazing. The yellow stone-ware is glazed by dipping the baked ware in water, in which is suspended a mixture of pounded flint, glass, and oxide of lead. In the glazing of some kinds of stone-ware, oxide of tin enters into the composition with the oxide of lead, and gives a whiter glaze. All the coarser kinds of pottery are glazed with oxide of lead; this promoting so much the fusion and vitrification, that the low heat at which they are baked is sufficient.

POTSTONE, or lapis ollaris. Colour greenish-grey. Massive, and in granular concretions. Glistening. Fracture curved foliated. Translucent on the edges. Streak white. Soft. Sectile. Feels greasy. Somewhat tough. Sp. gr. 2.8. Its constituents are, silica 39, magnesia 16, oxide of iron 10, carbonic acid 20, water 10. It occurs in thick beds in primitive slate. It is found abundantly on the shores of the lake Como in Lombardy. It is fashioned into culinary vessels in Greenland.

POUNCE, gum sandarach pounded and sifted very fine, to rub on paper, in order to preserve it from sinking, and to make it more fit to write upon. Pounce is also a little heap of charcoal dust, inclosed in a piece of muslin or some other open stuff, to be passed over holes pricked in a work, in order to mark the lines or designs on paper, silk, &c. placed underneath; which are to be afterwards finished with a pen and ink, a needle, or the like.

POWER, in mechanics, denotes any force, whether of a man, a horse, a spring, the wind, water, &c. which being applied to a machine tends to produce motion.

Power *of attorney*, an instrument, or deed, whereby a person is authorised to act for another, either generally or in a specific transaction.

This power is always revoked by the death of the grantor, and no person who has a power of attorney can grant a power under him.

PRÆMUNIRE. This punishment is inflicted upon him who denies the king's supremacy the second time; upon him who affirms the authority of the pope, or refuses to take the oath of supremacy; upon such as are seditious talkers of the inheritance of the crown; and upon such as affirm that there is any obligation by any oath, covenant, or engagement whatsoever, to endeavour a change of government either in church or state; or that both or either house of parliament have or has a legislative power without the king, &c.

PRAYER, a petition offered to the Almighty for some future favour. This is not the place for an essay on the important subject of prayer, but surely it may be allowable to remark that all prayer, in order to its being acceptable before the Great Being to whom it is addressed, must be presented in faith and sincerity, otherwise it is only an insult offered to the Divine Majesty; and this, it is to be feared, is the case with the greater part of the public prayers with which our ears have become familiar by long use.

PREBENDARY, an ecclesiastic who enjoys a prebend. The difference between a prebendary and a canon is, that the former receives his prebend, in consideration of his officiating in the church; but the latter merely by his being received into the cathedral or college.

PRECEDENCE, or Precedency, a place of honour to which a person is entitled: this is either of courtesy or of right. The former is that which is due to age, estate, &c. which is regulated by custom and civility: the latter is settled by authority, and when broken in upon gives an action at law.

The order of precedency, which is observed in general, is thus: that persons of every degree of honour or dignity take place according to the seniority of their creation, and not of years, unless they are descended from the blood-royal; in which case, they have place of all others of the same degree.

PRECENTOR, a dignitary in cathedrals, popularly called the chantor, or master of the choir.

PRECESSION *of the equinoxes*, is a very slow motion of them, by which they change their place, going from east to west, or backward, *in antecedentia*, as astronomers call it, or contrary to the order of the signs.

PREDICATE, in logic, that part of a proposition which affirms or denies something of the subject: thus, in these propositions, snow is white, ink is not white, whiteness is the predicate which is affirmed of snow, and denied of ink.

PREROGATIVE, is a word of large extent, including all the rights and privileges which by law the king has as chief of the common wealth, and as intrusted with the execution of the laws.

Prerogative *court*; the court wherein all wills are proved, and all administrations taken which belong to the archbishop by his prerogative; that is, in case where the deceased had goods of any considerable value out of the diocese wherein he died; and that value is ordinarily 5*l.* except it is otherwise by composition between the said archbishop and some other bishop, as in the diocese of London it is 10*l.*

PRESBYTERIANS, a sect of protestants, so called from their maintaining that the government of the church appointed in the new testament was by presbyteries; that is, by ministers and ruling elders, associated for its government and discipline.

But the appellation presbyterian, is in England appropriated to a large denomination of dissenters, who have no attachment to the Scotch mode of church government any more than to episcopacy among us; and, therefore, to this body of Christians the term presbyterian is improperly applied.

PRESS, the name given to a machine for compressing any substance or substances together, and retaining them under that compression as long as may be requisite.

PRIMITIVE, in grammar, is a root or original word in a language, in contradistinction to derivative. Thus, *God* is a primitive, *godly*, derivative, and *god like* a compound.

PRIMOGENITURE, the right of first-born. This right seems to be an unjust prerogative, and contrary to the natural right; for since it is birth alone gives children a title to the paternal succession, the chance of primogeniture should not throw any inequality among them.

PRIMUM *mobile*, in the Ptolemaic astronomy, the ninth or highest sphere of the heavens, whose centre is that of the universe.

PRINCE, in polity, a person invested with the supreme command of a state, independent of any other. Prince also denotes a person who is a sovereign in his own territories, yet holds of some other as his superior; such are the princes of Germany, who, though absolute in their respective principalities, are bound to the emperor in certain services. Prince also denotes the issue of princes, or those of the royal family. In France, they are called princes of the blood.

PRINCIPAL, the chief and most necessary part of a thing. In commerce, principal is the capital of a sum due or lent, so called in opposition to interest. It also denotes the first fund put by partners into a common stock, by which it is distinguished from the calls or accessions afterwards required.

PRINT, the impression taken from a copper-plate.

PRINTING, the art of taking impressions from characters or figures moveable or immoveable, on paper, linen, silk, &c. There are four kinds of printing, one from moveable letters for books; another from copper plates, for pictures; a third from blocks, in which the representation of birds, flowers, &c. are cut for printing calicoes, linens, &c. and the fourth by solid pages cast for the printing of books; the first, called common press-printing, the second rolling press-printing, the third calico, &c. printing; and the last stereotype printing.

The method of printing from moveable type is now so well known, that we need not here offer a detail of the process. The method of printing linen and paper for hangings, has been practised in the East from time immemorial. Printing from wooden blocks has been known in China for more than 1660 years. When a work is to be stereotyped, it is fairly transcribed upon a thin transparent paper. Each leaf is then reversed, and fixed upon a smooth block of hard wood, where the characters are engraven in relief; there is therefore a separate block for each page. The Italians, Germans, Flemings, and Dutch, began to engrave on wood and copper, about the end of the fourteenth century, and inscriptions in relief upon monuments and altars, in cloisters, and over church porches, became models for block-printing; and the letters upon painted windows, strongly resemble those in books of images.

The invention of cards in France, in the reign of Charles the Wise, about the year 1376, was an intermediate step. They were soon introduced into Spain, Italy, Germany, and England. At first the cards were painted; afterwards, about the year 1400, a method was devised of printing them from blocks, and to this we may trace the art of printing. From the next step resulted the books of images, printed from wooden blocks; one side of the leaf only was impressed, the corresponding text was placed below, at the side, or it issued from the mouth of the figure; the idea of stereotype printing is, therefore, not of modern origin.

Towards the close of the seventeenth century, this art, therefore, was practised in Holland. William Ged, of Edinburgh, in the year 1725, made the first use of this art in Britain; but owing to some defect in the plan, or want of skill in its execution, the invention attracted little notice.

In 1782, Mr. Alexander Tilloch, editor of the Philosophical Magazine, revived, or rather re-discovered this art; for he is said to have been ignorant of Ged's contrivance long after he had announced his own. In the subsequent year, he took out a patent for it, in conjunction with Mr. Andrew Foulis, printer to the university of Glasgow. Mr. Tilloch, however, removing to London, the concern was dropped altogether; not, however, until several small volumes had been stereotyped and printed, under the direction of these gentlemen.

About the year 1789, M. Didot, of Paris, applied the stereotype art to logarithmic tables, and afterwards to several of the Latin classics, and to various French publications; he introduced several important improvements, which render his mode more convenient and useful than that of any of his predecessors. The French, as usual, claim the merit of the invention, but our readers must soon perceive to whom this honour properly belongs. The name stereotype seems first to have been employed by M. Didot; it is derived from στερεος, *solidus*, and τυπος, *typus*, denoting that the types were soldered, or otherwise connected together.

Some years after Mr. Tilloch had given up the prosecution of this art, Mr. Wilson, a printer, of London, engaged with Earl Stanhope, for the purpose of bringing it to perfection, and eventually to establish it in this country. After two years application, the stereotype art was, in January 1804, with the approbation of Earl Stanhope, offered to the University of Cambridge, and accepted by them. Their bibles, testaments, and prayer-books, were printed in this manner. The plan was followed by the Bible Society, and other persons, for printing books of extensive sale and permanent demand, as bibles, dictionaries, grammars, &c. &c. The stereotype art has much the advantage of common printing for such purposes, wherein no alteration, as to plan or size, is allowed to take place. But for the common and general purposes of the

art of printing, the method by moveable types is incontestably the best.

The process of preparing the stereotype is now much improved, and is in general conducted thus. A page of any work intended to be stereotyped, is set up in the usual manner, with the ordinary moveable types. From this page, when corrected, a mould in plaster, the basis of which is gypsum, is taken off, and from this mould an impression is cast in the ordinary type metal, from which the printing is made. In this way each page of the work is set up, and from these casts, plates are procured, from which impressions may be made exactly the same in every particular as that from the moveable types originally set up.

A stereotype plate, therefore, is simply a fac-simile of the page from which it was taken, with this advantage, that it does not require to be more than the seventh or eighth part of the thickness or height of the common types.

After the plate has been cast, several little imperfections appear on it, which are easily removed by appropriate tools; the back of the plate is then turned perfectly level in a lathe, that it may lie flat in the press.

In nothing connected with mechanical science, has there been more emulation displayed than in the construction of the printing press. We have now the improved Stanhope press, the Columbian press, Barclay's American press, Mr. Ruthven's press; Bacon and Donkin's, Applegarth's, and Bensley's printing machines, with others of less note. All these possess their peculiar advantages over the old common printing press; but mature experience seems to have given a decided preference to the Columbian press. This press was invented by Mr. George Clymer, of Philadelphia, now of London.

The principal excellences of this press are the following. The power is obtained by a combination of levers instead of a screw, and is much greater than that of any other printing press. This power is susceptible of gradation to the smallest as well as to the largest forms, and is equally well adapted to all kinds of work, from the smallest card to the heaviest double royal sheets. In this press also an extra degree of care is taken, to make the surface of the iron platten, and that of the iron bed for the types, perfectly level; thus an equal pressure on every part of the sheet is insured. It is found also that by this press much less injury is done to the types than by any other press, since from its great power a very sharp impression may be obtained without sinking into the paper.

PRINTERS, *Marks of,* are those marks used by the correctors of the press, to point out the errors of the proof sheets, that the compositor may amend them before the work is printed off.

The corrections are placed on the margin of every page, against the line in which the faults are found: and there are different characters used to express different corrections: thus ₰ is put for dele, to intimate that something, as a point, letter, word, &c. dashed in that line, is to be taken out. If any thing is to be inserted, the place is to be marked thus ∧ and the thing to be inserted added in the margin. When there are two or more corrections in the same line, then they are all separated in the margin by little bars, thus /. If a space is omitted, its place is marked with a caret, and in the margin thus #. When a letter is inverted, it is expressed in the margin thus ℘. When any thing is to be transposed it is directed thus, Extraordinary scarce ever fail of attainments exciting envy, for Extraordinary attainments scarcely ever fail of exciting envy, and in the margin is added *trs.* If Italic characters are to be changed for Roman, or vice versa, a line is drawn thus — under the letters, and *Rom.* or *Ital.* is written in the margin. If a space, or an m or an n quadrat, stick up, and print black, it is marked in the margin with a dash, thus | If a word, sentence, or paragraph, is entirely omitted, the place is marked with a caret, and in the margin is put the word *out.* If the letters of a word stand too far asunder, a line is drawn under them, and in the margin is put a crooked line or hook, thus ‿. There are many other marks used in correcting, as ✓ for superior, *cap.* for capital, *l. c.* for lower-case, &c.

PRISM, in geometry, an oblong solid, contained under more than four planes, whose bases are equal, parallel, and alike situated.

Prism, in dioptrics, a triangular glass-prism, much used in experiments about the nature of light and colours. See Optics.

PRISTIS, or saw-fish, a genus of fishes of the order chondropterigii: the generic character is, snout long, flat, spinous down the edges, spiracles lateral; body oblong, roundish, covered with a rough, coriaceous skin; mouth beneath; nostrils before the mouth, half-covered with a membranaceous flap; behind the eyes two oval orifices; ventral fins approximate. There are five species.

PRIVATEERS, in maritime affairs, a kind of private ships of war, fitted out by private persons at their own expense; who have leave granted them to keep what they can take from the enemy, allowing the admiral his share.

PRIVY *council,* is the principal council belonging to the king, and is generally called by way of eminence the council. Privy counsellors are made by the king's nomination, without either patent or grant; and on taking the necessary oaths they become immediately privy counsellors, during the life of the king that chooses them, but subject to removal at his discretion.

PRIZE, in sea affairs, a vessel taken from the enemies of a state, or from pirates, either by a man-of-war, a privateer, &c. having a commission for that purpose. Vessels are looked on as prize, if they fight under any other standard than that of the state from which they have their commission.

PROBATE. See Will.

PROBE, a surgeon's instrument for examining the circumstances of wounds, &c. See Surgery.

PROBLEM, in logic, is a proposition that neither appears absolutely true nor false; and consequently may be asserted either in the affirmative or negative.

PROBLEMATICAL RESOLUTION, in algebra, a method of solving difficult questions by certain rules called canons.

PROBOSCIS, in natural history, is the trunk or snout of an elephant, and some other beasts and insects.

PROCEDENDO, in law, a writ whereby a plea or cause, formerly called from an inferior court to the court of chancery, king's bench, or court of common pleas, by writ of privilege, habeas corpus, or certiorari, is released and returned to the other court to be proceeded in, upon its appearing that the defendant has no cause of privilege, or that the matter in the party's allegation is not well proved.

PROCELLARIA, in ornithology, a genus of birds belonging to the order of anseres. The beak is somewhat compressed, and without teeth; the mandibles are equal, the superior one being crooked at the point; the feet are palmated, the hind claw being sessile, without any toe. Mr. Latham enumerates twenty-four species, which are principally distinguished by their colour.

PROCTOR, a person commissioned to manage another person's cause in any court of the civil or ecclesiastical law. The proctors of the clergy, are the representatives chosen by the clergy to sit in the lower house of convocation: of these there are two for each diocese, and one for each collegiate church.

PROCURATOR, a person who has a charge committed to him to act for another. Thus the proxies of the lords in parliament are, in our law-books, called procurators; the bishops are sometimes called procuratores ecclesiarum; and the representatives sent by the clergy to convocation, procuratores cleiici.

PROCYON, in astronomy, a fixed star of the second magnitude in the constellation called canis minor. See Canis.

PRODUCING, in geometry, signifies the drawing out a line farther till it has any assigned length.

PRODUCT, in arithmetic and geometry, the factum of two or more numbers, or lines, &c. into one another: thus 5 × 4 = 20 the product required.

PROFILE, the draught of a building, fortification, &c. See Architecture.

Profile, also denotes the outline of a figure, building, member of architecture, &c.

Profile, in sculpture and painting, denotes a head, portrait, &c., when represented sideways, or in a side view. On almost all medals, faces are represented in profile.

PROGRESSION, an orderly advancing or proceeding in the same manner, course, tenor, proportion, &c.

Progression is either arithmetical or geometrical.

Progression, *Arithmetical*, is a series of quantities proceeding by continued equal differences, either increasing or decreasing. Thus,

increasing 1, 3, 5, 7, 9, &c. or
decreasing 21, 18, 15, 12, 9, &c.;

where the former progression increases continually by the common difference 2, and the latter series or progression decreases continually by the common difference 3.

1. And hence to construct an arithmetical progression, from any given first term, and with a given common difference; add the common difference to the first term, to give the 2nd; to the 2nd, to give the 3rd; to the 3rd, to give the 4th; and so on; when the series is ascending or increasing: but subtract the common difference continually, when the series is a descending one.

PROHIBITION, is a writ properly issuing only out of the court of king's bench, being the king's prerogative writ; but, for the furtherance of justice, it may now also be had in some cases out of the court of chancery, common pleas, or exchequer, directed to the judge and parties of a suit in an inferior court, commanding them to cease from the prosecution thereof, upon a suggestion, that either the cases originally, or some collateral matter arising therein, does not belong to that jurisdiction, but the cognizance of some other court.

PROJECTILES, the science of the motion, velocity, flight, range, &c. of a projectile put into violent motion by some external cause, as the force of gunpowder, &c. This is the foundation of gunnery, under which article may be found all that relates peculiarly to that branch.

PROJECTION. In perspective, projection is the appearance or representation of an object on the perspective plane. The projection of the sphere is either orthographic, or stereographic. The former, or orthographic projection, supposes the eye placed at an infinite distance; whereas, in the stereographic projection, it is supposed to be only 90 degrees distant from the primitive circle, or placed in its pole, and thence viewing the circles on the sphere. The primitive circle is that great circle which limits or bounds the representation or projection; and the place of the eye is called the projecting point.

PROLATE, in geometry, an epithet applied to a spheroid produced by the revolution of a semi-ellipsis about its larger diameter.

PROMISE, is where, upon a valuable consideration, persons bind themselves by words to do or perform such a thing agreed on; it is in the nature of a verbal covenant, and wants only the solemnity of writing and sealing to make it absolutely the same. Yet for the breach of it, the remedy is different; for instead of an action of covenant, there lies only an action upon the case, the damages whereof are to be estimated and determined by the jury.

PROMISSORY NOTE. See Bills of Exchange.

PRONOUN, in grammar, a declinable part of speech, which being put instead of a noun, points out some person or thing.

PROOF, the shewing or making plain the truth of any matter alleged; either in giving evidence to a jury on a trial, or else on interrogatories, or by copies of records, or exemplifications of them.

PROPORTION, is often confounded with ratio; but they are quite different things. For ratio is properly the relation of two magnitudes or quantities of one and the same kind; as the ratio of 4 to 8, or 15 to 30, or of 1 to 2, and so implies or respects only two terms or things. But proportion respects four terms or things, or two ratios which have each two terms: though the middle term may be common to both ratios, and then the proportion is expressed by three terms only, as 4, 8, 64, where 4 is to 8 as 8 to 64.

PROPOSITION, in logic, part of an argument wherein some quality, either negative or positive, is attributed to a subject.

PROSODY, that part of grammar which treats of the quantities and accents of syllables and the manner of making verses.

PROSOPŒIA, a figure in rhetoric, whereby we raise qualities, or things inanimate, into persons.

PROTEST, when one openly affirms, that he does either not at all, or but conditionally, yield his consent to any act, or unto the proceeding of a judge in court wherein his jurisdiction is doubtful, or to answer upon his oath any farther than by law he is bound.

PROTEST, is also that act by which the holder of a foreign bill of exchange declares that such bill is dishonoured.

PROTEST, is also that act of a master, on his arrival with his ship from parts beyond the seas, to save him and his owners harmless and indemnified from any damage sustained in the goods of her lading, on account of storms. See BILLS of EXCHANGE, and INSURANCE.

PROTESTANT, a name first given in Germany to those who adhered to the doctrine of Luther; because in 1529, they protested against a decree of the emperor Charles V. and the diet of Spires; declaring that they appealed to a general council. The same name also has been given to those of the sentiments of Calvin, and is now become a common denomination for all those of the reformed churches.

PROTHONOTARY, a term which properly signifies first notary, and which was anciently the title of the principal notaries of the emperors of Constantinople.

Prothonotary with us is used for an officer in the king's bench and common pleas; the former of which courts has one, and the latter three.

PROTESTATION, is a form in pleading, when one does not directly affirm or deny any thing that is alleged by another, or which he himself alleges.

PROTRACTOR, is the name of an instrument used for protracting or laying down on paper the angles of a field, or other figure. The protractor is a small semicircle of brass, or other solid matter, the limb or circumference of which is nicely divided into one hundred and eighty degrees: it serves not only to draw angles on paper, or any plane, but also to examine the extent of those already laid down.

PROVIDENCE, the conduct and direction of the several parts of the universe by a superior intelligent being.

On the subject of providence an eminent philosopher and profound Theologian has the following truly appropriate remarks:

"It is Jehovah from whom order is derived, hence it may be said that Jehovah is order itself; for from himself, he ruleth over order, not in the universal only, as is commonly supposed, but in the most particular things; for particulars are what constitute an universal, and to talk of an universal, and thence to separate particulars, would be like talking of a whole in which there are no parts, and thus like talking of something in which there is nothing; consequently it is most false, and merely notional, to say that the Lord's providence is universal, and not at the same time most particular; for to provide and rule in the universal, and not at the same time in the most particular things, is not to provide nor rule at all.

This is philosophically true, and yet it is surprising that philosophers themselves, even the most sublime and exalted, conceive and think otherwise."

PROVISO, in law, a condition inserted in a deed, upon the observance whereof the validity of the deed depends.

PROVOST, an officer, whereof there are divers kinds, civil, military, &c.

PROVOST, of a city or town, is the chief municipal magistrate in several trading cities, particularly Edinburgh, Glasgow, &c. being much the same with the mayor in other places. He presides in city-courts, and, together with the baillies, who are his deputies, determines in all differences that arise among citizens.

PROW, in navigation, denotes the head or fore part of a ship, particularly in a galley, being that which is opposite to the poop or stern. In the middle of the prow is the beak that cuts the water, on the top of which is commonly some figure or hieroglyphic.

PRUNELLA, a genus of the gymnospermia order, in the didynamia class of plants; and in the natural method ranking under the 12th order, holoraceæ. The filaments are bifurcated, the stigma is bifid. There are three species, herbs of Europe.

PRUNELLÆ, in pharmacy, a preparation of purified saltpetre.

PRUNES, in commerce, are plums dried in the sun-shine, or in an oven.

PRUNING, in gardening and agriculture, is the lopping off the superfluous branches of trees, in order to make them bear better fruit, grow higher, or appear more regular. Pruning though an operation of very general use, is nevertheless rightly understood by few; nor can it be learned by rote, or indeed wholly by books, but requires a strict observation of the different manners of growth of the several sorts of fruit trees; the proper method of doing which cannot be known, without carefully observing how each kind is naturally disposed to produce its fruit; for some do this on the same year's wood as vines; others for the most part upon the former year's wood, as peaches, nectarines, &c. and others, upon spurs which are produced upon wood of three, four, &c. to fifteen or twenty years old, as pears, plums, cherries, &c. therefore, in order to the right management of fruit trees, provision should always be made to have a sufficient quantity of bearing wood in every part of the trees, and at the same time there should not be a superfluity of useless branches, which would exhaust the strength of the trees, and cause them to decay in a few years. The reasons for pruning of fruit-trees, are, 1. To preserve them longer in a vigorous bearing state; 2. To render them more beautiful; and, 3. To cause the fruit to be larger and better tasted.

PRUNUS, a genus of the monogynia order, in the icosandria class of plants; and in the natural method ranking under the 36th order, pomaceæ. The calyx is quinquefid, inferior: there are five petals; the fruit is a plum, having a kernel with prominent sutures. There are 33 species.

PRUSSIC ACID, is one of the most powerful and important of the acids. The following brief account of it is from the Chemical Dictionary of Dr. Ure, to which we would refer the reader for a most interesting account of this remarkable substance.

The combination of this acid with iron was

long known and used as a pigment by the name of Prussian blue, before its nature was understood. Macquer first found that alkalis would decompose Prussian blue, by separating the iron from the principle, with which it was combined in it, and which he supposed to be phlogiston. In consequence, the prussiate of potash was long called *phlogisticated alkali*. Bergman, however, from a more scientific consideration of its properties, ranked it among the acids; and, as early as 1772, Sage announced, that this animal acid, as he called it, formed with the alkalis neutral salts, that with potash forming octaedral crystals, and that with soda rhomboids or hexagonal laminæ. About the same time Scheele instituted a series of sagacious experiments, not only to obtain the acid separate, which he effected, but also to ascertain its constituent principles.

Scheele's method is this: Mix four ounces of prussian blue with two of red oxide of mercury prepared by nitric acid, and boil them in twelve ounces by weight of water, till the whole becomes colourless; filter the liquor, and add to it one ounce of clean iron filings, and six or seven drams of sulphuric acid. Draw off by distillation about a fourth of the liquor, which will be Prussic acid; though, as it is liable to be contaminated with a portion of sulphuric, to render it pure, it may be rectified by redistilling it from carbonate of lime.

This prussic acid has a strong smell of peach blossoms, or bitter almonds; its taste is at first sweetish, then acrid, hot, and virulent, and excites coughing; it has a strong tendency to assume the form of gas; it has been decomposed in a high temperature, and by the contact of light, into carbonic acid, ammonia, and carburetted hydrogen. It does not completely neutralize alkalis, and is displaced even by the carbonic acid; it has no action upon metals, but unites with their oxides, and forms salts for the most part insoluble; it likewise unites into triple salts with these oxides and alkalis: the oxygenated muriatic acid decomposes it.

From the experiments of M. Magendie it appears, that the pure hydrocyanic acid is the most violent of all poisons. When a rod dipped into it is brought in contact with the tongue of an animal, death ensues before the rod can be withdrawn. If a bird be held a moment over the mouth of a phial containing this acid, it dies. In the Annales de Chimie for 1814 we find this notice: M. B. Professor of Chemistry, left by accident on a table, a flask containing alcohol impregnated with Prussic acid; the servant, enticed by the agreeable flavour of the liquid, swallowed a small glass of it. In two minutes she dropped down dead, as if struck with apoplexy. The body was not examined.

"Scharinger, a professor at Vienna," says Orfila, "prepared six or seven months ago a pure and concentrated prussic acid; he spread a certain quantity of it on his naked arm, and died a little time after."

Dr. Magendie has, however, ventured to introduce its employment into medicine. He found it beneficial against phthisis and chronic catarrhs. His formula is the following:—

Mix one part of the pure prussic or hydrocyanic acid of M. Gay Lussac with 8½ of water by weight. To this mixture he gives the name of medicinal Prussic acid.

Of this he takes	1 gros.	or	59 gr. Troy
Distilled water,	1 lb.	or	7560 grs.
Pure sugar,	1½ oz.	or	708¾ gr.

And mixing the ingredients well together, he administers a table-spoonful every morning and evening.

PSITTACUS, or *parrot*, a genus belonging to the order of picæ. The bill in this genus is hooked from the base; and the upper mandible is moveable: the nostrils are round, placed in the base of the bill, which in some species is furnished with a kind of cere; the tongue is broad, and blunt at one end: the head is large, and the crown flat; the legs are short, the toes placed two before and two behind. Parrots are found almost every where within the tropics; and in their natural state they live on fruits and seeds, though, when tame, they will eat flesh and even fish.

PTOLEMAIC, or *Ptolemean system of astronomy*, is that invented by Claudius Ptolemæus, a celebrated astronomer and mathematician of Pelusium in Egypt, who lived at the beginning of the second century of the Christian æra.

This hypothesis supposes the earth immoveably fixed in the centre, not of the world only, but also of the universe; and that the sun, the moon, the planets, and stars, all move about it from east to west, once in 24 hours, in the order following: viz. the Moon next to the Earth, then Mercury, Venus, the Sun, Mars, Jupiter, Saturn, the fixed stars, the first and second crystalline heavens, and above all, the fiction of their primum mobile.

PUDDING *stone*, in chemistry, a term invented by English lapidaries to designate one particular mineral aggregate, consisting of oblong and rounded pebbles of flint, about the size of almonds, imbedded in a hard siliceous cement. The pebbles are usually black, and the cement a light yellowish brown. It is capable of receiving a very high polish, and is used in ornamental works. It is found chiefly in Essex.

PULEX, in natural history, the *flea*, a genus of insects of the order aptera. Generic character: mouth without jaws or feelers, with a long inflected proboscis, covered at the base with two ovate laminæ; the sheat two-valved, five-jointed, and concealing a single bristle; lip rounded and fringed with reflected prickles; antennæ projecting, moniliform; two eyes; abdomen compressed; six legs formed for leaping.

PULLEY, in mechanics, one of the mechanical powers, called by seamen a tackle. See Mechanics.

PULSE, in the animal economy denotes the beating or throbbing of the heart and arteries.

Pulse. See Legumen.

PUMICE-*stone*, or *porous glasses*. When the compact glasses are exposed to the heat of our furnaces, they emit a great number of air-bubbles, which renders them porous: such is the origin of pumice. It has the same base as compact glass. The texture is fibrous; the fibres have a silky lustre. Colours various, white, brown, yellow, black. Before the blow-pipe, they melt into a white enamel.

PUMP. See Hydraulics.

PUNCH, an instrument of iron or steel, used

in several arts for the piercing or stamping holes in plates of metals, &c. being so contrived as not only to perforate, but to cut out and take away the piece. The punch is a principal instrument of the metal button-makers, wafer-makers, patch-makers, shoe-makers, &c.

PUNCHEON, a little block or piece of steel, on one end whereof is some figure, letter, or mark, engraven either in creux or relievo, impressions whereof are taken on metal, or some other matter, by striking it with a hammer on the end not engraved. There are various kinds of these puncheons used in the mechanical arts; such for instance are those of the goldsmiths, cutlers, pewterers, &c.

PURCHASE, in law, the buying or acquiring of lands, &c. with money, by deed or agreement, and not by descent or right of inheritance. A joint purchase is when two or more persons join together in the purchase.

PURITAN, a name formerly given in derision to the dissenters from the church of England, on account of their professing to follow the pure word of God, in opposition to all traditions and human constitutions.

PURPLE, a colour composed of a mixture of red and blue. See DYEING.

PURSER, an officer aboard a man of war, who receives her victuals from the victualler, sees that it is well stowed, and keeps an account of what he every day delivers to the steward.

PUS. The liquid called pus is secreted from the surface of an inflamed part, and usually moderates and terminates the inflammation. It assumes different appearances according to the state of the sore. When it indicates a healing sore, it is called healthy or good-conditioned pus. This liquid possesses the following properties:

It is of a yellowish-white colour, and of the consistence of cream. Its taste is insipid, and it has no taste when cold. Before the microscope it exhibits the appearance of white globules swimming in a transparent fluid.

PUTREFACTION. The spontaneous decomposition of such animal or vegetable matters, as exhale a fetid smell, is called putrefaction. The solid and fluid matters are resolved into gaseous compounds and vapours which escape, and into an earthy residuum. As the grand resolvent of organic matter is water, its abstraction by drying, or fixation by cold, by salt, sugar, spices, &c. will counteract the process of putrefaction. The atmospheric air is also active in putrefaction; hence, its exclusion favours the preservation of food; on which principle, some patents have been obtained.

PUTTY, in the arts. When tin is melted in an open vessel, its surface soon becomes covered with a grey powder, which is an oxide of the metal. If the heat is continued, the colour of the powder gradually changes, and at last becomes yellow. In this state it is known by the name of putty, and employed in polishing glass and other hard substances.

PUTTY is also a kind of paste compounded of whiting and linseed-oil, beaten together to the consistence of a thick dough. It is used by glaziers for the fastening in the squares of glass in sash-windows, and by painters for stopping up the crevices and clefts in timber and wainscots, &c.

PUZZULANA or POZZOLANA, *terra*, or *terrus*, is a greyish kind of earth used in Italy for building under water. The best is found about Puteoli, Baiæ, and Cumæ, in the kingdom of Naples, from the first of which places it derives its name. It is supposed to be a volcanic product, composed of heterogeneous substances thrown out from the burning mouths of volcanoes in the form of ashes; sometimes in such large quantities, and with so great violence, that whole provinces have been covered with it at a considerable distance.

PYRAMID, in geometry, a solid standing on a triangular, square or polygonal basis, and terminating in a point at the top; or, according to Euclid, it is a solid figure consisting of several triangles, whose bases are all in the same plane, and which have one common vertex.

There are several pyramids in Egypt, but those at Gizeh are the most gigantic; and the most enormous, or the great pyramid, is situated near Memphis. Herodotus says, he was informed the latter covered the remains of Cheops, and another adjoining those of his brother Cephrenes, who succeeded him; the first only having inner galleries, or passages. Although much dependence cannot be placed upon the further accounts of this ancient writer, it seems highly probable that an 100,000 men may have been constantly employed, for 20 years, in efecting the immense pile, and that Cheops became detested by the people, who were thus taken from more useful employments, as well as by the bulk of the population, who found the taxes demanded of them appropriated to a purpose utterly unproductive of future advantage.

PYRITES, a genus of inflammable substances composed of sulphur, which has dissolved or saturated itself with metals. Thus there are many kinds of pyrites; as of gold, arsenic, iron, &c.

PYROLIGNEOUS *acid*, or, as it is sometimes termed, *vinegar of wood*, is a substance likely to become of great use as an animal antiseptic. From the low price at which it is sold it is adapted for general use; more particularly, as it not only preserves the food from putrefaction, but also gives to it that smoky and acid taste peculiar to well dried hams and red-herrings. Indeed, the only difference in using this acid, and drying by turf or wood smoke, seems to be merely the mode of operation; for in both cases this acid is the agent employed. In one case, the animal substance is acted on during the distillation of the acid and in the other the already formed acid is applied to the substance by immersion.

This acid, the product of the distillation of wood, is now well known in Britain as an article of commerce, and in its native state is a liquid of the colour of white wine, possessing a strong acid and slightly astringent taste, combined with an empyreumatic smell. When allowed to remain in a state of rest for eight or ten days, tar of a black colour subsides, and the acid is then comparatively transparent. To purify it further, it undergoes the process of distillation, by which it is freed from a still greater portion of the tar with which it is combined, and is thus rendered still more transparent. But though the process of distillation be repeated without end, it will never be freed from the volatile oil with which it is combined,

and which is the cause of the empyreuma constantly attending it. In short, it contains the same properties for the preservation of animal matters from putrefaction as smoking them by wood does, which is practised at present by the most barbarous nations, and which has been handed down from the remotest ages of antiquity.

PYROMETER. The most celebrated instrument for measuring high temperatures is that invented by the late Mr. Wedgewood, founded on the principle, that clay progressively contracts in its dimensions, as it is progressively exposed to higher degrees of heat. He formed his white porcelain clay into small cylindrical pieces, in a mould, which, when they were baked in a dull red heat, just fitted into the opening of two brass bars, fixed to a brass plate, so as to form a tapering space between them. This space is graduated; and the farther the pyrometric clay gauge can enter, the greater heat does it indicate. The two converging rules are placed at a distance of 0.5 of an inch at the commencement of the scale, and of 0.3 at the end.

PYROPHORUS. By this name is denoted an artificial product, which takes fire or becomes ignited on exposure to the air. Hence, in the German language, it has obtained the name of luft-zunder, or air-tinder. It is prepared from alum by calcination, with the addition of various inflammable substances.

Dr. Ure has made a very good pyrophorus by simply mixing three parts of alum with one of wheat-flour, calcining them in a common phial till the blue flame disappeared; and has kept it in the same phial, well stopped with a good cork when cold.

If this powder be exposed to the atmosphere, the sulphuret attracts moisture from the air, and generates sufficient heat to kindle the carbonaceous matter mingled with it.

PYROTECHNY, the art of fire, or a science which teaches the management and application of fire in several operations. But the term is more particularly used to denote the doctrine of artificial fireworks.

On this subject, which would require a distinct volume, we can only here offer a brief outline, at the same time referring the student to an able article under this head in the Edinburgh Encyclopædia.

The principal ingredients used in the process of artificial firework making, are,—1. saltpetre, purified for the purpose; 2. sulphur; and 3. charcoal. Gunpowder is likewise used in the composition of fire-works, being first ground, or, as it is technically termed, mealed. Camphor and gum-benzoin are employed as ingredients in odoriferous fire-works. The proportions of the materials differ very much in different fire-works, and the utmost care and precaution are necessary in the working them to a state fit for use, and then in the mixing. In this work we cannot enter on the subject with a sufficient degree of minuteness to teach the method of making fire-works, and we shall therefore content ourselves with a brief notice of the proportions of the materials in some of the more common, and more interesting articles in use.

The charges for sky-rockets are made of saltpetre, four pounds; brimstone, one pound; and charcoal one pound and a half; or by another direction, saltpetre, four pounds; brimstone, one pound and a half; charcoal, twelve ounces; and meal powder, two ounces. These proportions vary again according to the size of the rocket; in rockets of four ounces, mealed-powder, saltpetre, and charcoal, are used in the proportions of 10 : 2 and 1; but in very large rockets the proportions are saltpetre, four; mealed-powder and sulphur one each. When stars are wanted, camphor, alcohol, antimony, and other ingredients are required according as the stars are to be blue, white &c. In some cases gold and silver rain is required; then brass-dust, steel-dust, saw-dust, &c. enter into the composition; hence the varieties may be almost indefinite. With respect to colour, sulphur gives a blue, camphor a white or pale colour, saltpetre a clear white yellow, sal-ammoniac a green, antimony a reddish, rosin a copper colour.

To the above may be added NITRATE of STRONTIAN, the effect of which is to produce a fine crimson light of indescribable richness and beauty. See STRONTIAN.

PYRUS, the *pear tree*, a genus of the pentagynia order, in the icosandria class of plants, and in the natural method ranking under the 36th order pomaceæ. The calyx is quinquefid; there are five petals; the fruit is an apple, inferior, quinquelocular, and polyspermous. To this genus Linnæus has joined the apple and quince. There are thirteen species.

PYTHIAN GAMES, in antiquity, solemn games celebrated near Delphi in honour of Apollo, and in remembrance of his having killed the serpent Python.

These were held every two years, about the month of Elaphebolion, which answers to our February.

Q.

Q, or q, the sixteenth letter of our alphabet. As a numeral, it stands for 500; and with a dash over it, thus $\bar{Q}$, for 500,000. Used as an abbreviature, q signifies quantity or quantum: thus, among physicians, q. pl. is quantum placet, *i. e.* as much as you please of a thing; and q. s. quantum sufficit, *i. e.* as much as is necessary. Q. E. D. among mathematicians, is quod erat demonstrandum, *i. e.* which was to be demonstrated; and Q. E. F. quod erat faciendum, *i. e.* which was to be done

Q. D. among grammarians, is quasi dictum, *i. e.* as if it was said, or, as who should say. In the notes of the ancients, Q stands for Quintus or Quintius; Q. B. V. for quod bene vertat Q. S. S. S. for quæ supra scripta sunt; Q. M. for Quintus Mutius, or quomodo; Quint. for Quintilius; and Quæs. for quæstor.

QUACK, a medical impostor, who "for the good of the public," and "by the blessing of God," undertakes with his powders, potions, or balsam, to cure "all disorders." Thus, igno

rance and blasphemy unite in picking the pockets and ruining the constitution of thousands of credulous people in this and other countries. The pretension to infallibility in any one medicine, as a cure for any one disorder, is next to absurd: much more ridiculous is it then to suppose, that any medicine will remove all kinds of complaints.

QUADRANGLE, in geometry, the same with a quadrilateral figure, or one consisting of four sides and four angles. To the class of quadrangles belong the square, parallelogram, trapesium, rhombus, and rhomboides. A square is a regular quadrangle; a trapesium an irregular one.

QUADRANS, the quarter or fourth part of any thing, particularly the *as*, or pound.

QUADRANT, denotes a mathematical instrument, of great service in astronomy, and, consequently, in navigation, for taking the altitudes of the sun and stars; as also for taking angles in surveying. Those chiefly in use, are Adams's, Cole's, Gunter's, Hadley's, Sutton's, or Collins's, the horodictical, the sinical, the astronomical, and the common surveying quadrant.

Of the common Quadrant.

This instrument, ABC, fig. 1, Plate XLVI. is made of brass, or wood, &c. the limb or arch of which BC is divided into 90°, and each of these is farther divided into as many equal parts as the space will allow, either diagonally or otherwise. To one of the radii AC, are fitted two moveable sights; and to the centre is sometimes also annexed a label, or moveable index, AD, bearing two other sights; but, instead of these last sights, there is sometimes fitted a telescope. Also from the centre hangs a thread with a plummet; and on the under side or face of the instrument are fitted a ball and socket, by means of which it may be put into any position. The general use of it is for taking angles in a vertical plane, comprehended under right lines going from the centre of the instrument, one of which is horizontal, and the other is directed to some visible point. But besides the parts above described, there is often added on the face, near the centre, a kind of compartment EF, called a quadrat, or geometrical square, which is a kind of separate instrument, and is particularly useful in altimetry and longimetry, or measuring heights and distances.

Of Cole's Quadrant.

This is a very useful instrument, invented by Mr. Benjamin Cole. It consists of six parts, viz. the staff AB, fig. 2, the quadrantal arch DE; three vanes A, B, C; and their vernier FG. The staff is a bar of wood about two feet long, an inch and a quarter broad, and of a sufficient thickness to prevent it from bending or warping. The quadrantal arch is also of wood, and is divided into degrees and third parts of degrees, to a radius of about nine inches; and to its extremities are fitted two radii, which meet in the centre of the quadrant by a pin, about which it easily moves. The sight-vane A is a thin piece of brass, near two inches in height and one broad, set perpendicularly on the end of the staff A, by means of two screws passing through its foot. In the middle of this vane is drilled a small hole, through which the coincidence or meeting of the horizon and solar spot is to be viewed. The horizontal vane B is about an inch broad, and two inches and a half high, having a slit cut through it of near an inch long, and a quarter of an inch broad; this vane is fixed in the centre-pin of the instrument, in a perpendicular position, by means of two screws passing through its foot, by which its position with respect to the sight-vane is always the same, their angle of inclination being equal to 45 degrees. The shade-vane C is composed of two brass plates. The one which serves as an arm, is about 4½ inches long, and ¾ of an inch broad; being pinned at one end to the upper limb of the quadrant by a screw, about which it has a small motion; the other end lies in the arch, and the lower edge of the arm is directed to the middle of the centre-pin. The other plate, which is properly the vane, is about two inches long, being fixed perpendicularly to the other plate, at about half an inch distance from that end next the arch; this vane may be used either by its shade, or by the solar spot cast by a convex lens placed in it. And because the wood-work is often subject to warp or twist, therefore this vane may be rectified by means of a screw, so that the warping of the instrument may occasion no error in the observation, which is performed in the following manner: set the line G on the vernier against a degree of the upper limb of the quadrant, and turn the screw on the backside of the limb forward or backward, till the hole in the sight-vane, the centre of the glass, and the sunk spot in the horizon-vane, lie in a right line.

Of Collin's or Sutton's Quadrant.

From an inspection of the figure, it will be seen that this quadrant, fig. 3, is a stereographic projection of one quarter of the sphere between the tropics, upon the plane of the ecliptic, the eye being in its north pole; and fitted to the latitude of London. The lines running from right to left, are parallels of altitude; and those crossing them are azimuths. The smaller of the two circles bounding the projection, is one quarter of the tropic of Capricorn; and the greater is a quarter of the tropic of Cancer. The two ecliptics are drawn from a point on the left edge of the quadrant, with the characters of the signs upon them; and the two horizons are drawn from the same point. The limb is divided both in degrees and time; and by having the sun's altitude, the hour of the day may here be found to a minute. The quadrantal arches next the centre contain the calendar of months; and under them, in another arch, is the sun's declination On the projection are placed several of the most remarkable fixed stars between the tropics; and the next below the projection are the quadrant and line of shadows

Of Gunter's Quadrant.

This quadrant is represented at fig. 4, and is so called from its inventor, Edmund Gunter. Besides the apparatus of other quadrants, this has a stereographic projection of the sphere on the plane of the equinoctial; and also a calender of the months, next to the divisions of the limb; by which, besides the common purposes of other quadrants, several useful questions in astronomy, &c. are easily resolved. To find the sun's meridian altitude for any given day

versely the day of the year answering any given meridian altitude. Lay the thread to the day of the month in the scale next the limb; then the degree it cuts in the limb is the sun's meridian altitude. And contrariwise, the thread being set to the meridian altitude, it shows the day of the month.

Of Hadley's Quadrant.

Fig. 5 exhibits this instrument as it is usually constructed. It is properly an octant, and is by far the most complete instrument of the kind ever invented: its utility and correctness have obtained for it the name of "*portable observatory.*" The following are its principal parts: B C, the arc of 45°; A D, the index, moving on a pivot, under the centre of the index-glass, E; which glass is in the exact direction of the index, and stands at right angles upon it. F, the fore horizon-glass, which receives the reflection from the index-glass. G, the back horizon-glass. The former stands parallel with the leg, A C; the latter at right angles to it. K is a pivot, on which three dark glasses, or screens move, so that any one, or more, may be placed between the index-glass and the horizon-glass, to diminish the lustre of the reflected planet. H and I, the vanes, or sights. The arc, B C, is called the limb, or quadrantal arc; what is beyond 0, is the arc of excess: the residue of the arc usually is graduated up as far as 100°.

A large portion of the lower part of the index is open, so as to show the gradations on the arc: the lower edge is chamfered, that it may come close down to them, and is there divided into smaller portions: this scale is called the nonius, and shows the smaller divisions in a more correct and obvious manner than could be done by the quadrantal arc, on which each degree is subdivided into no more than three equal parts, of 20′ each. Now the nonius, being divided into 21 equal parts, shows at what portions of the arc the index cuts the division of 20 minutes; therefore it shows every minute.

The Use of Hadley's Quadrant.

For the Fore-Observation.—Bring the index close to the bottom, so that the middle of the Vernier's scale, or nonius, stand against 0 degrees. Hold the plane of the instrument vertical, with the arch downwards; look through the right-hand hole in the vane, and direct the sight through the transparent part of the horizon-glass, to observe the horizon. If the horizon-line, seen both in the quicksilvered part, and through the transparent part, should coincide, or make one straight line, then is the glass adjusted; but if one of the horizon-lines should stand above the other, slacken the screw in the middle of the lever, backwards or forwards, as there may be occasion, until the lines coincide: fasten the screw in the middle of the lever, and all is ready for use.

To take the sun's altitude.—Fix the screens above the horizon-glass, using either or both of them, according to the strength of the sun's rays, by turning one or both the frames of those glasses close against the plane or face of the instrument; then your face being turned towards the sun, hold the quadrant by the braces, or by either radius, as is found most convenient, so as to be in a vertical position, with the arch downwards. Put the eye close to the right-hand hole in the vane, look at the horizon through the transparent part of the horizon-glass, at the same time sliding the index with the left hand, until the image of the sun, seen in the quicksilvered part, falls in with the edge of the horizon, taking either the upper or the under edge of the solar image. Swing your body gently from side to side; and when the edge of the sun is observed not to cut, but to touch the horizon-line, like a tangent, the observation is made. Then will the degrees on the arch, reckoning from the end next your body, give the altitude of that edge of the sun which was brought to the horizon. If the lower edge was observed, then sixteen minutes, added to the said degrees, gives the altitude of the sun's centre; but if the upper edge was used, the sixteen minutes must be subtracted.

To take the altitude of a star.—Look directly up at the star, through the vane, and transparent part of the glass; the index being close to the button: then will the image of the star, by refraction, be seen in the silvered part, right against the star seen through the other part. Move the index forward, and, as the image descends, let the quadrant descend also, to keep it in the silvered part, till it comes down in a line with the horizon, seen through the transparent part, and the observation is made.

To make an artificial horizon.—Often when the atmosphere is clear above, the horizon is so laden with vapours, as to prevent an observation being taken. In such case, an artificial horizon is to be made thus: fill into any vessel, having a diameter of about three inches, and about half an inch deep, from one to two pounds of quicksilver, on which lay a metal speculum, or a piece of plain glass, whose diameter may be about one-third of an inch less than that of the surface of quicksilver: in this the image of the sun may be seen distinctly. Sling the vessel, so that it may remain level, and take an observation with a stained glass, which will subdue the great brilliancy of the reflection. The observation thus taken, will be as correct as if taken by means of the natural horizon.

Quadrant *of altitude,* is a thin piece of metal, in general applied to the globe, and marked with the degrees, from 0 to 90°: when laid upon the meridian of any place, it shows its latitude, or distance from the equator.

Quadrant *of a circle,* or the fourth part of its circumference, is contained under two radii standing at right angles. The quadrant contains ninety degrees, and is the parent of various lines of the greatest utility in many branches of the mathematics, such as the lines of chords, of sines, of latitude, &c.

QUADRAT, a mathematical instrument, called also a geometrical square, and line of shadows; it is frequently an additional member on the face of the common quadrant, as also on those of Gunter's and Sutton's quadrant.

Quadrat, in printing, a piece of metal cast to fill up the spaces between the words, at the close of paragraphs, and other open places. The quadrats are of different sizes, as m quadrats

n quadrats, &c. which are, respectively, of the dimensions of these letters.

QUADRATIC *equation*, in algebra, that wherein the unknown equality is of two dimensions, or raised to the second power. See ALGEBRA.

QUADRATURE, in geometry, denotes the squaring, or reducing a figure to a square. Thus, the finding of a square, which shall contain just as much surface, or area; as a circle, an ellipsis, a triangle, &c. is the quadrature of a circle, ellipsis, &c.

QUADRATURE, in astronomy, that aspect of the moon when she is 90° distant from the sun; or when she is in a middle point of her orbit, between the points of conjunction and opposition, namely, in the first and third quarters.

QUADRATURE-*lines*, are two lines placed on Gunter's sector: they are marked with Q, and 5, 6, 7, 8, 9, 10: of which Q signifies the side of the square, and the other figures the side of the polygons of 5, 6, 7, &c. sides. S, on the same instrument, stands for the semidiameter of a circle, and 90 for a line equal to 90° in circumference.

QUADRILATERAL, in geometry, a figure whose perimeter consists of four right lines, making four angles; whence it is also called a quadrangular figure. The quadrilateral figures are either a parallelogram, trapezium, rectangle, square rhombus, or rhomboides.

QUADRILLE, a game at cards, sometimes called ombre by four; which chiefly differs from ombre by three, in being played by four persons; and having all the forty cards dealt out, to each person at ten each.

QUAKERS, a religious sect who appeared in England about the year 1650. The origin will be best given in their own words: "The beginning of the seventeenth century is known to have been a time of great dissension in England, respecting religion; many pious persons having been dissatisfied with the settlement of the church of England in the reign of queen Elizabeth. Various societies of dissenters had accordingly arisen; some of whom evinced their sincerity by grievous sufferings under the intolerance of those who governed church affairs. But these societies, notwithstanding their honest zeal, seemed to have stopped short in their progress towards a complete reformation; and, degenerating into formality, to have lost their most enlightened members, and still to lament the want of something more instructive and consolatory to the soul, than the most rigorous of their ordinances had ever produced. Thus, dissatisfied and disconsolate, they were ready to follow any teacher, who seemed to be able to direct them to that light of peace of which they felt the need. Many in succession engaged their attention; until finding the insufficiency of them all, they withdrew from the community of every visible church, and dwelt retired, and attentive to the inward state of their own minds."

The quakers have places of worship, where they regularly assemble on the sabbath, though sometimes without vocal prayer, or any religious or practical exhortation. They reject water-baptism and the Lord's supper, have no distinct order of ministers, and are firm advocates for the Arminian system of doctrine. Their internal government is much admired; their own poor are supported without parochial aid, and their industry and sobriety are deserving of imitation. They also reprobate the destructive practice of war, the infamous traffic of slaves, and profess their abhorrence of religious persecution. Refusing to pay tithes, they suffer the loss of their goods and of their liberty, rather than comply with the demand, and their *losses* are emphatically termed by them *sufferings*. As the quakers cannot be made to take an oath in a court of justice, their affirmation is permitted in all civil, but not in criminal cases. Towards the close of the 16th century, the respectable William Penn, who founded Pennsylvania, introduced and established a large and flourishing colony of them in America, where they are now very numerous.

QUALITY, is defined by Mr. Locke, to be the power in a subject of producing any idea in the mind: thus a snow-ball having the power to produce in us the ideas of white, cold, and round, these powers, as they are in the snow-ball, he calls qualities; and as they are sensations, or perceptions, in our understandings, he calls ideas.

QUANTITY, any thing capable of estimation, or mensuration; or which, being compared with another thing of the same kind, may be said to be greater or less than it, equal or unequal to it.

QUANTITY, in grammar, an affection of a syllable, whereby its measure, or the time wherein it is pronounced, is ascertained; or that which determines the syllable to be long or short.

QUANTUM, *valebant*, in like manner is where goods and wares sold are delivered by a tradesman at no certain price, or to be paid for them as much as they are worth in general; and the plaintiff is to aver them to be worth so much.

QUARANTINE, a trial which ships undergo when suspected of having on board persons infested with a pestilential disease. Physicians are occasionally consulted on this subject by government, who regulate this unpleasant restriction on the commerce of the country by their judgment, as to the period of time within which the effects of any infection received by any individual on board, would be shown. The usual quarantine is forty days. This may be ordered by the king, with the advice of the privy-council, at such times, and under such regulations, as he judges proper. Ships ordered on quarantine must repair to the place appointed, and must continue there during the time prescribed, without having any intercourse with the shore, except for necessary provisions, which are conveyed with every possible precaution. When the time is expired, and the goods opened and exposed to the air as directed, if there be no appearance of infection they are admitted to port. Ships infected with the pestilence must proceed to St. Helen's Pool in the Scilly islands, and give notice of their situation to the Custom-house officers, and wait till the king's pleasure be known.

QUARRY, a place under ground, out of which are got marble, free-stone, slate, lime stone, or other matters proper for buildings.

QUARTER, the fourth part of any thing, the fractional expression for which is ¼. Quar-

ter, in weights, is generally used for the fourth part of a hundred weight avoirdupois, or 28lbs.

Used as the name of a dry measure quarter is the fourth part of a ton in weight, or eight bushels.

Quarter, in heraldry, is applied to the parts or members of the first division of a coat that is quartered or divided into four quarters.

Quarter *of a point*, in navigation, is the fourth part of the distance between two cardinal points, which is 2° 48′.

Quarter *of a ship*, is that part of a ship's hold which lies between the steerage-room and the transom.

Quarter-*masters*, or **quarteers**, in a ship of war, are officers whose business it is to rummage, stow, and trim, the ship in the hold; to overlook the steward in his delivery of victuals to the cook, and in pumping or drawing out beer, or the like. They are also to keep their watch duly, in conning the ship, or any other duty.

QUARTERING, in gunnery, is when a piece of ordnance is so traversed that it will shoot on the same line or on the same point of the compass as the ship's quarter bears.

QUARTERS, a name given at sea to the several stations where the officers and crew of a ship of war are posted in action.

QUARTER *sessions*. See **Sessions**.

QUARTZ, a mineral of the flint genus, which is divided into five sub-species: viz. the amethyst, the rock-crystal, milk quartz, common quartz and prase.

QUASSIA, a genus of the monogynia order, in the decandria class of plants, and in the natural method ranking under the 14th order gruinales. The calyx is pentaphyllous; there are five petals; the nectarium is pentaphyllous; there are from two to five seed-cases, standing asunder, and monospermous. There are three species, the amara, simaruba, and excelsa.

This tree is so named from Quassi, a negro slave, who first discovered the nature of its wood. Besides its use in medicine, quassia is often used by brewers to communicate a bitter taste to the beer, instead of hops.

QUEEN, a woman who holds a crown singly. The title of queen is also given by way of courtesy to her that is married to a king, who is called by way of distinction queen-consort.

A queen-consort is inferior to the king, and is really his subject, though, as the king's wife, she has several prerogatives above other women.

QUERCUS, the *oak tree*, a genus of the polyandria order, in the monœcia class of plants, and in the natural method ranking under the 50th order, amentaceæ. The calyx is nearly quinquefid; there is no corolla; the stamina are from five to ten in number. The female calyx is monophyllous, very entire, and scabrous. There is no corrolla; the styles are from two to five; and there is an ovate seed.

The English oak claims precedence as a timber-tree, for its prodigious height and bulk, and superior worth of its wood. The oak is remarkable for its slowness of growth, bulk, and longevity. It has been remarked that the oak has attained to the size only of fourteen inches in diameter, and some to twenty, in the space of four score years.

QUICK, or **quickset hedge**, among gardeners, denotes all live hedges, of whatsoever sort of plants they are composed, to distinguish them from dead hedges; but in a more strict sense of the word, it is restrained to those planted with the hawthorn, or cratægus oxyacantha, under which name these young plants, or sets, are sold by the nursery-gardeners, who raise them for sale.

QUICKSILVER. See **Mercury**.

QUILLS, are the large feathers taken out of the end of the wings of geese, ostriches, crows, &c. They are denominated from the order in which they are fixed in the wing; the second and third quills being the best for writing, as they have the largest and roundest barrels. Crow quills are chiefly used for drawing.

QUILTING, a method of sewing two pieces of silk, linen, or stuff, on each other, with wool or cotton between them; by working them all over in the form of chequer or diamond work, or in flowers.

QUINCE. See **Pyrus**.

QUINCUNX, in Roman antiquity, denotes any thing that consists of five-twelfth parts of another, but particularly of the as.

QUINDECAGON, in geometry, a plan figure with fifteen sides and 15 angles, which, if the sides are all equal, is termed a regular quindecagon, and irregular when otherwise.

The side of a regular quindecagon inscribed in a circle is equal in power to the half-difference between the side of the equilateral triangle, and the side of the pentagon inscribed in the same circle; also the difference of the perpendiculars let fall on both sides, taken together.

QUIRE of paper, a quantity of 24 or 25 sheets.

QUITAM, in law, is where an action is brought, or an information exhibited, against a person, on a penal statute, at the suit of the king and the party or informer, when the penalty for breach of the statute is directed to be divided between them; in that case, the informer prosecutes as well for the king as himself.

QUIT-*claim*, in law, signifies a release of any action that one person has against another It signifies also a quitting a claim or title to lands, &c.

QUIT-*rent*, in law, a small rent that is payable by the tenants of most manors, whereby the tenant goes quit and free from all other services. Anciently this payment was called white-rent, on account that it was paid in silver coin, and to distinguish it from rent corn.

QUOIN, or *Coin*, on board a ship, a wedge fastened on the deck, close to the breech of the carriage of a gun to keep it firm up to the ship's side.

QUOITS, a kind of exercise or game known among the ancients under the name discus.

QUO MINUS, is a writ which issues out of the court of exchequer to the king's farmer or debtor, for debt, trespass, &c. Though this writ was formerly granted only to the king's tenants or debtors, the practice now is become general for the plaintiff to surmise, that by the wrong the defendant does him, he is the less able to satisfy his debt to the king, by which means jurisdiction is given to the court of exchequer to determine the cause. This writ is to take the body of the defendant in like manner as the capias in the common pleas, and the writ of latitat in the king's bench.

QUO WARRANTO, in law, a writ which lies against a person or corporation that usurps any franchise or liberty against the king; as to have a fair, market, or the like, in order to oblige the usurper to shew by what right and title he holds or claims such franchise. This writ also lies for mis-user or non-user of privileges granted. The attorney-general may exhibit a quo-warranto in the crown office against any particular persons, or bodies politic or corporate, who use any franchise or privilege without having a legal grant or prescription for the same; and a judgment obtained upon it is final, as being a writ of right.

R.

R, the seventeenth letter of our alphabet. In the notes of the ancients, R. or RO. signifies Roma; R. C. Romana civitas; R. G. C. rei gerendæ causa; R. F. E. D. recte factum et dictum; R. G. F. regis filius; R. P. res publica, or Romani principes; and R. R. R. F. F. F. res Romana ruet ferro, fame, flamma.

Used as a numeral, R. anciently stood for eighty, and with a dash over it, thus $\bar{R}$, for 80,000; but the Greek r, or ρ, signified 100.

RABBETING, in carpentry, the planing or cutting of channels or grooves in boards. In ship-carpentry, it signifies the letting-in of the planks of the ship into the keel; which, in the rake and run of a ship, is hollowed away, that the planks may join the closer.

RABBIT. See LEPUS.

RACHITIS. See MEDICINE.

RACK, an infernal engine of torture, furnished with pullies and chords; &c. for extorting confession from criminals. This instrument is happily banished from almost every civilized state of the world. The trial by the rack was never known to the law of England.

RADICAL. That which is considered as constituting the distinguishing part of an acid, by its union with the acidifying principle, or oxygen, which is common to all acids. Thus, sulphur is the radical of the sulphuric and sulphurous acids. It is sometimes called the base of the acid, but base is a term of more extensive application.

RADIAL CURVES, are curves of the spiral kind, whose ordinates, if they may be so called, all terminate in the centre of the including circle, appearing like radii of that circle, whence the name.

RADIUS, in geometry, the semidiameter of a circle, or a right line drawn from the centre to the circumference. See CIRCLE, and GEOMETRY.

RADIUS. See ANATOMY.

RAFT, a sort of float, formed by an assemblage of various planks or pieces of timber fastened together side by side, so as to be conveyed more commodiously to any short distance in a harbour or road than if they were separate.

RAFTERS, in building, are pieces of timber, which standing by pairs on the raising piece, meet in an angle at the top, and form the roof of a building.

RAG WORT. See SENECIS.

RAGG, *rowley*, a genus of stones belonging to the siliceous class. It is of a dusky or dark-grey colour, with many small shining crystals, having a granular texture, and acquiring an ochry crust by exposure to the air.

RAILWAY, a species of road or carriage-way, in which the track of the carriage-wheels being laid with bars, or rails, of wood, stone, or metal, the carriage is more easily drawn along this smooth surface than over an ordinary road. On some rail-ways in England, the waggons are drawn by means of a steam engine working in a waggon by itself, the wheels of which are driven by the engine, and acting on a rack laid along the road, impel forward both the engine and the attached waggons: in some instances the wheels of the waggon operate by mere friction, and require not the aid of the rack-work. The engines used for this purpose are of the high pressure kind, which require no condensing apparatus. This application of steam, however, has not yet arrived at such perfection as to obtain general adoption; and the present unprecedented mania for rail-ways over the country, to supersede the excellent inland navigation which has done so much for our commerce, is likely to terminate as all such dreams have hitherto done, viz. in the disappointment and loss of many for the enriching of a few.

RAIN. Mr. Luke Howard, who may be considered as our most accurate scientific meteorologist, is inclined to think, that rain is in almost every instance the result of the *electrical* action of clouds upon each other. This idea is confirmed by observations made in various ways, upon the electrical state of clouds and rain; and it is very probable that a thunder-storm is only a more sudden and sensible display of those energies, which, according to the order observable in the creation in other respects, ought to be incessantly and silently operating for more general and beneficial purposes. See METEOROLOGY.

RAINBOW. See OPTICS.

RAISING-*pieces*, in architecture, are pieces that lie under the beams, and over the posts or puncheons.

RAISINS, grapes prepared by suffering them to remain on the vine till they are perfectly ripe, and then drying them in the sun, or by the heat of an oven. The difference between raisins dried in the sun, and those dried in ovens, is very obvious: the former are sweet and pleasant; but the latter have a latent acidity with the sweetness, that renders them much less agreeable.

RAKE *of a ship*, is all that part of her hull which hangs over both ends of her keel. That which is before is called the fore-rake, or rake-forward; and that part which is at the setting on of the stern-post, is called the rake-aft or afterward.

RALLUS, the *rail*, in ornithology, a genus belonging to the order of grallæ. The beak is thickest at the base, compressed, equal, acute, and somewhat sharp on the back near the

point; the nostrils are oval; the feet have four toes, without any web; and the body is compressed. Mr. Latham, in his Index Ornithologicus, enumerates 24 species, besides some varieties. They are chiefly distinguished by their colour. "These birds (says Buffon) constitute a large family, and their habits are different from those of the other shore-birds which reside on sands and gravel. The rails, on the contrary, inhabit only the slimy margins of pools and rivers, especially low grounds covered with flags and other large marsh-plants.

RAM, in zoology, the male of the sheep kind. See Ovis.

Ram, *battering*, in antiquity, a military engine used to batter and beat down the walls of places besieged.

RAMPANT. See Heraldry.

RAMPART, in fortification, is an elevation of earth, round a place capable of resisting the cannon of an enemy; and formed into bastions, curtains, &c. See Fortification.

RAMPHASTOS, in ornithology, a genus belonging to the order of picæ. The bill is very large, and serrated outwardly. The nostrils are situated behind the base of the beak; and in most of the species the feet are toed, and placed two forwards and two backwards. The tongue is long, narrow, and feathered on the edges. Mr. Latham enumerates 15 different species, of which the toucans are the most remarkable.

RANA, *frog*, a genus of amphibia of the order reptiles; the generic character is, body four-footed, without tail, and naked, or without any integument but the skin.

This genus may be divided into three sections, viz. 1. Frogs, commonly so called, or ranæ, with light active bodies, and which leap when disturbed. 2. Slender-limbed frogs, hylæ, calamitæ, or ranæ arboreæ, viz. such as have light bodies, very slender limbs, and toes terminating in flat, circularly expanded, tips, enabling the animals to adhere at pleasure to the surface even of the smoothest bodies. Several of this division generally reside on trees, adhering by their toes to the lower surfaces of the leaves and branches. 3. Toads, bufones, or such as have large heavy bodies, short thick limbs, and which rather crawl than leap when disturbed.

RANCIDITY. The change which oils undergo by exposure to the air.

The rancidity of oils is probably an effect analogous to the oxidation of metals. It essentially depends on the combination of oxygen with the extractive principle, which is naturally united with the oily principle. This inference is proved by attending to the processes used to counteract or prevent the rancidity of oils.

RANDOM *shot*, in gunnery, is a shot made when the muzzle of a gun is raised above the horizontal line, and is not designed to shoot directly, or point blank. The utmost random of any piece is about ten times as far as the bullet will go point blank. The bullet will go furthest when the piece is mounted to about forty-five degrees above the level range.

RANGE, in gunnery, the path of a bullet, or the line it describes from the mouth of the piece to the point where it lodges.

RANGER, a sworn officer of a forest, appointed by the king's letters-patent, whose business is to walk through his charge to drive back the deer out of the purlieus, &c. and to present all trespasses within his jurisdiction at the next forest-court.

RANGES, in a ship, two pieces of timber that go across from side to side; the one on the forecastle, a little abaft the fore mast; and the other in the beak-head, before the wouldings of the bowsprit.

RANK, in war, is a row of soldiers placed side by side.

Rank, the order or rank assigned a person suitable to his quality or merit.

RANUNCULUS, *crowfoot*, a genus of the polygamia order in the polyandria class of plants, and in the natural method ranking under the 26th order, multisiliquæ. There are 59 different species of this genus; six or eight of which claim general esteem as flowery plants for ornamenting the gardens.

RAPE, in law, is where a man has carnal knowledge of a woman by force, and against her will; by 18 Eliz. c. 7, if any person shall unlawfully and carnally know and abuse any woman-child under the age of ten years, whether with her consent or against it, he shall be punished as for a rape. And it is not a sufficient excuse in the ravisher to prove that she is a common strumpet; for she is still under the protection of the law, and may not be forced. Nor is the offence of a rape mitigated by shewing that the woman at last yielded to the violence, if such her consent was forced by fear of death or duress; nor is it any excuse that she consented after the fact.

RAPE is also a name given to a division of a county, and sometimes means the same as a hundred, and at other times signifies a division consisting of several hundreds.

RAPHANUS, *radish*, a genus of the siliquosa order, in the tetradynamia class of plants, and in the natural method ranking under the 39th order, siliquosæ. The calyx is close: the siliqua torose, or swelling out in knots, subarticulated, and round. There are two melliferous glandules between the shorter stamina and the pistil, and two between the longer stamina and the calyx. There are six species; the sativus, or common garden-radish is best known, and of this there are several varieties.

RAREFACTION, in physics, the act whereby a body is brought to possess more room, or appear under a larger bulk, without the accession of any new matter.

RASH, in medicine, an eruption upon the skin, thrown out in fevers or surfeits.

RAT. See Mus.

RATAFIA, a spirituous liquor, prepared from the kernels, &c. of several kinds of fruit, particularly of cherries and apricots. Ratifia of cherries is prepared by bruising the cherries and putting them into a vessel wherein brandy has been long kept; then adding to them the kernels of cherries, with strawberries, sugar, cinnamon, white pepper, nutmegs, cloves; and to twenty pounds of cherries, ten quarts of brandy. The vessel is left open ten or twelve days, and then stopped close for two months before it is tapped.

RATCH, in clock-work, a sort of wheel having twelve fangs, which serve to lift up the detents every hour, and make the lock strike

RATCHETS, in a watch, are the small teeth at the bottom of the fusee or barrel, which stops it in winding up.

RATES, in the navy, the orders or classes into which the ships of war are divided, according to their force and magnitude. The regulation which limits the rates of men of war to the smallest number possible, seems to have been dictated by considerations of political economy, or of the simplicity of the service in the royal dock-yards. The British fleet is accordingly distributed into six rates, exclusive of the inferior vessels that usually attend on naval armaments: as sloops of war, armed-ships, bomb-ketches, fire-ships, and cutters, or schooners commanded by lieutenants.

RATIO, in arithmetic and geometry; is that relation of homogeneous things which determines the quantity of one from the quantity of another, without the intervention of a third.

RATION, in the army, a portion of ammunition, bread, drink, and forage, distributed to each soldier in the army, for his daily subsistence, &c. The horse have rations of hay and oats when they cannot go out to forage. The rations of bread are regulated by weight. The ordinary ration of a foot soldier is a pound and a half of bread per day. The officers have several rations, according to their quality and the number of attendants that they are obliged to keep.

RATIONAL, is applied to integral, fractional, and mixt numbers; Thus we say, rational fraction, rational integer, and rational mixt number.

RATIONALE, a solution, or account of the principles of some opinion, action, hypothesis, phænomenon, or the like.

RATLINES, or, as the seamen call them, RATLINS, those lines which make the ladder-steps to get up the shrouds and futtocks, hence called the ratlins of the shrouds.

RATTLE *snake*. See CROTALUS.

RAVELIN, in fortification, was anciently a flat bastion, placed in the middle of a curtain, but now a detached work, composed only of two faces, which make a saliant angle, without any flanks, and raised before the curtain on the counterscarp of the place. A ravelin is a triangular work resembling the point of a bastion, with the flanks cut off. Its use before a curtain is to cover the opposite flanks of the two next bastions.

RAVEN. See CORVUS.

RAY, a genus of fishes of the class amphibia, and of the order nantes. The generic character is, mouth situated beneath the head, transverse, beset with teeth; spiracles beneath, five on each side the neck; body in most species sub-rhomboidal.

This genus, of which there are 19 species, is distinguished by the remarkable breadth and thinness of the body, the pectoral fins appearing like a continuation of the sides themselves, being covered with the common skin. Those best known to us are the thorn-back, and the skate. As an edible fish, the skate is considered as one of the best of its tribe, and is an established article in the European markets, being found in great plenty in the adjoining seas, where it usually frequents the shores in the manner of flat fish. It breeds in the month of March and April, and deposits its ova from May to September.

RE-ACTION, in physiology, the resistance made by all bodies to the action or impulse of others, that endeavour to change its state whether of motion or rest. See MOTION.

REAGENT. In the experiments of chemical analysis, the component parts of bodies may either be ascertained in quantity as well as quality, by the perfect operations of the laboratory, or their quality alone may be detected by the operations of certain bodies called reagents. Thus the infusion of galls is a reagent, which detects iron by a dark purple precipitate; the prussiate of potash exhibits a blue with the same metal.

REALGAR, in chemistry. Arsenic, mineralized by sulphur, forms two ores, named orpiment and realgar, the chemical distinction of which is not very accurately determined. That which has been named realgar is of a red colour, sometimes inclining to scarlet, sometimes to orange. It occurs massive, disseminated, and crystallized, in oblique, tetrahedral or hexaedral prisms, generally small and translucent, or semitransparent, with a shining lustre. Its fracture is uneven: it is soft and brittle, and has a specific gravity of 3.2, or 3.3. It exhales before the blow-pipe a white arsenical smoke, with an arsenical and sulphurous odour, and gives a blue flame. It consists of arsenic and sulphur in the proportions of 80 of the former, and 20 of the latter.

REASONING, the exercise of the faculty of the mind called reasoning; or it is an act or operation of the mind, deducing some unknown propositions from other previous ones that are evident and known.

REACH, in the sea language, signifies the distance between any two points of land, lying nearly in a right line.

REBATE, or REBATEMENT, in commerce, a term much used at Amsterdam, for an abatement in the price of several commodities, when the buyer, instead of taking time, advances ready money.

REBELLION, taking up arms traitorously against the king, be it by natural subjects, or by others once subdued.

RECEIPTS, are acknowledgments in writing of having received a sum of money or other value. A receipt is either a voucher for an obligation discharged, or one incurred. Receipts for money above 40*s*. must be on stamps; but on the back of a bill of exchange, or promissory note, which is already stamped, is good without a farther duty. Writing a receipt on a stamp of greater value than the law requires, incurs no penalty, and the receipt is good; but if on a stamp of a lower value, or on unstamped paper, then a receipt is no discharge, and incurs a penalty.

RECEIVER, in pneumatics, a glass vessel for containing the thing on which an experiment in the air-pump is to be made.

RECEIVER, in chemistry, a vessel of earth, glass, &c. for receiving any distilled liquor.

RECEPTACLE, in botany, one of the seven parts of fructification, which, according to Linnæus, is the base which connects or supports the other parts. A proper receptacle obtains different names from the parts of the

fructification which supports and connects. When both flower and fruit are supported by it, it is generally styled the receptacle of the fructification. When the receptacle supports the parts of the flower only, it is called the receptacle of the flower.

RECIPE, in medicine, a prescription or remedy, to be taken by a patient; so called, because always beginning with the word *recipe*, i. e. *take;* which is generally denoted by the abbreviature R.

RECIPROCAL *terms*, among logicians, are those which have the same signification; and consequently are convertible, or may be used for each other.

RECITATIVO, or Recitative, in music, a kind of singing, that differs but little from ordinary pronunciation, such as that in which the several parts of the liturgy are rehearsed in cathedrals; or that in which the actors commonly deliver themselves on the theatre at the opera, when they are to express some action or passion, to relate some event, or reveal some design.

RECKONING, or a Ship's Reckoning, in navigation, is that account by which at any time it may be known where the ship is, and on what course or courses she is to steer, in order to gain her port; and that account taken from the log-board is called the dead-reckoning.

RECOGNIZANCE, is an obligation of record, which a man enters into before some court of record, or magistrate duly authorized, with condition to some particular act; as to appear at the assizes or quarter-sessions, to keep the peace, &c.

RECORD. An act committed to writing in any of the king's courts, during the term wherein it is written, is alterable, being no record; but that term once ended, and the act duly enrolled, it is a record, and of that credit which admits of no alteration or proof to the contrary.

RECORDARE facias, a writ directed to the sheriff, to remove a cause out of an inferior court, into the king's-bench or common-pleas.

RECORDER, a person whom the mayor and other magistrates of a city or corporation associate to them, for their better direction in matters of justice, and proceedings in law; on which account this person is generally a counsellor, or other person well skilled in the law.

RECOVERY, in law, is obtaining any thing by judgment or trial at law.

A recovery resembles a fine so far as being an action real or fictitious, and in that lands are recovered against the tenant of the freehold, and an absolute fee-simple is vested in the recoverer; but it is carried on through every stage of proceeding, instead of being compromised like a fine.

RECTANGLE, in geometry, the same with a right-angled parallelogram.

RECTANGLED, Rectangular, or Right-angled, appellations given to figures and solids which have one or more right angles: thus a triangle with one right angle, is termed a rectangled triangle; also parallelograms with right angles, squares, cubes, &c. are rectangular.

RECTIFICATION, the art of setting any thing to rights, and hence to rectify the globes, is to fit them for performing any problem.

Rectification, in geometry, is the finding a right line, equal in length to a curve.

Rectification, in chemistry, is nothing but the repetition of a distillation, or sublimation several times, in order to render the substance purer, finer, and freer from aqueous or earthy parts.

RECTORY, in law, is taken for an entire parish-church, with all its rights, glebes, tithes, and other profits whatsoever.

RECTUM, in anatomy, the third and last of the large intestines.

RECURVIROSTRA, in ornithology, a genus belonging to the order of grallæ. The bill is long, subulated, bent back, sharp and flexible at the point. The feet are webbed, and furnished with three toes forwards and a short one behind. Mr. Latham notes of this genus three species, viz. the avosetta, or the one commonly known, the Americana, and the alba. This last, it is probable, has some affinity to the Americana. The recurvirostra avosetta is about the size of a lapwing in body, but has very long legs. The American avoset is rather larger and longer than the last. The bill is similar, and its colour black; the forehead is dusky white; the head, neck, and upper part of the breast, are of a deep cream-colour; the lower parts of the neck behind white; the back is black, and the under parts from the breast pure white; the wings are partly black, partly white, and partly ash-coloured. The recurvirostra, or scolopax alba, is about 14 inches and a quarter long, its colour white, the inferior coverts of its wings duskish, its bill orange, its legs brown.

RED-BOOK of the exchequer, an ancient record or manuscript volume, in the keeping of the king's remembrancer, containing divers miscellaneous treatises relating to the times before the conquest.

REDEMPTION, in law, a faculty or right of re entering upon lands, &c. that have been sold and assigned, upon reimbursing the purchase-money with legal costs. Bargains wherein the faculty, or, as some call it, the equity, of redemption is reserved, are only a kind of pignorative contracts.

REDOUBT, or Redoute, in fortification, a small square fort, without any defence but in front, used in trenches, lines of circumvallation, contravallation, and approach, as also for the lodgings of corps de garde, and to defend passages. In marshy grounds, redoubts are frequently made of stone works, for the security of the neighbourhood: their face consists of from 10 to 15 fathoms, the ditch round them from 8 to 9 feet broad and deep, and their parapets have the same thickness.

REDUCTION *of a figure, design, or draught*, is the making a copy of it either larger or smaller than the original, still preserving the form and proportion. The great use of the proportional compasses is the reduction of figures, &c. whence they are called compasses of reduction. There are various methods of reducing figures, &c. The most easy is by means of the pentagraph, or parallelogram; but this has its defects.

REED. See Arundo.

REEF, a term in navigation. When there is a great gale of wind, they commonly roll up part of the sail below, that by this means it may become the narrower, and not draw so

much wind; which contracting or taking up the sail they call a reef, or reefing the sail; so also when a top-mast is sprung, as they call it, that is, when it is cracked, or almost broken in the cap, they cut off the lower piece that was nearly broken off, and setting the other part, now much shorter, in the step again, they call it a reefed top-mast.

REEL, in the manufactories, a machine serving for the office of reeling. There are various kinds of reels, some very simple, others very complex. Of the former kinds those most in use are, 1. A little reel held in the hand, consisting of three pieces of wood, the largest and longest of which (which does not exceed a foot and a half in length, and one fourth of an inch in diameter) is traversed by two other pieces disposed different ways 2. The common reel, or windlass, which turns upon a pivot, and has four flights traversed by long pins or sticks, whereon the skein to be reeled is put, and which are drawn closer or opened wider, according to the skein.

RE-ENTRY, in law, signifies the resuming or retaking a possession in land lately lost.

REFERENCE, in law, is where a matter is referred by the court of chancery to a master, and by the courts at law to a prothonotary, or secondary, to examine and report to the court. Reference also signifies where a matter in dispute is referred to the decision of an arbitrator.

REFINING, in general, is the art of purifying a thing; including not only the assaying or refining of metals, but likewise the depuration or clarification of liquors. Gold and silver may be refined by several methods, which are all founded on the essential properties of these metals, and acquire different names according to their kinds.

REFLECTING *circle*, an astronomical instrument for measuring angles. It is called reflecting from its property, in common with the Hadley's quadrant (of which it is a modification) of observing one of the objects of the angle to be measured by distinct vision, and the other by reflection of plane mirrors. The first instrument of this kind was invented by Tobias Mayers, in 1770, a celebrated astronomer of Gottingen, who calculated the lunar and solar tables for determining the longitude at sea, for which a reward of 3000*l.* was given by the board of longitude.

REFLECTION *of the rays of light*, in catoptrics, is their return, after approaching so near the surfaces of bodies, as to be repelled, or driven backwards. See **OPTICS**.

REGALIA, in law, the rights and prerogatives of a king; which, according to civilians, are six, viz. 1. The power of judicature. 2. The power of life and death. 3. The power of peace and war. 4. A right to such goods as have no owner, as waifs, estrays, &c. 5. Assessments. And, 6. The coinage of money.

Regalia is also used for the apparatus of a coronation, as the crown, the sceptre with the cross, that with the dove, St. Edward's staff, the globe, and the orb with the cross, four several swords, &c.

REGENT, one who governs a kingdom during the minority or absence of the king. In France, the queen-mother has the regency of the kingdom during the minority of the king, under the title of queen-regent.

REGENT also signifies a professor of arts and sciences in a college, who has a set of pupils under his care; but here regent is generally restrained to the lower classes, as regent of rhetoric, regent of logic, &c.; those of philosophy are rather called professors. The foreign universities are generally composed of doctors, professors, and regents.

REGIMEN, the regulation of diet, and, in a more general sense, of all the non-naturals, with a view to preserve or restore health.

REGIMENT, in war, is a body of men, either horse or foot, commanded by a colonel. Each regiment of foot is divided into companies, but the number of companies is not always alike, though our regiments generally consist of ten companies, one on the right of grenadiers, and another on the left of light troops. Regiments of horse most commonly consist of six troops, but some have nine. Regiments of dragoons, in time of war, are generally composed of eight troops, and in time of peace of six.

REGISTER, a public book in which are entered and recorded memoirs, acts, and minutes, to be had recourse to occasionally for knowing and proving matters of fact.

Of these there are several kinds; as, 1. Registers of deeds in Yorkshire and Middlesex, in which are registered all deeds, conveyances, wills, &c. that affect any lands or tenements in those counties, which are otherwise void against any subsequent purchasers, or mortgagees, &c. but this does not extend to any copyhold estate, nor to leases at a rack rent, or where they do not exceed 21 years. The registered memorials must be ingrossed on parchment, under the hand and seal of some of the grantors or grantees, attested by witnesses who are to prove the signing or sealing of them, and the execution of the deed.

Among dissenters who admit of infant baptism, each minister is supposed to keep a register of the several children baptized by him. But as these are frequently lost, by the succession of new ministers to the same congregation; or at best do not give an account of the date of the births, which may have happened many weeks or months before baptism, it is now almost generally the custom among dissenters of all denominations to register the births of their children at the Library in Red-cross Street, London.

REGISTER is also used for the clerk or keeper of a register. Of these we have several, denominated from the registers they keep; as register of the high court of delegates; register of the arches court of Canterbury; register of the court of admiralty; register of the prerogative court; register of the garter, &c.

REGISTER, in printing, is disposing the forms on the press, so that the lines and pages printed on one side of the sheet fall exactly on those of the other.

REGISTER, among letter-founders, is one of the inner parts of the mould in which the printing-types are cast. Its use is to direct the joining the mould justly together again, after opening it to take out the new-cast letter.

REGLETS, in printing, are thin slips of wood, exactly planed to the size of the body of the letter. The smaller sorts are placed between the lines of poetry; and both those and the larger are used in filling up short pages, in

forming the whites or distances between the lines of titles, and in adjusting the distances of the pages in the chase so as to form register.

REGULAR, denotes any thing that is agreeable to the rules of art: thus we say a regular building, verb, &c. A regular figure in geometry is one whose sides, and consequently angles, are equal; and a regular figure with three or four sides is commonly termed an equilateral triangle or square, as all others with more sides are called regular polygons. All regular figures may be inscribed in a circle. A regular solid, called also a Platonic body, is that terminated on all sides by regular and equal planes, and whose solid angles are all equal.

REGULATOR *of a watch*, the small spring belonging to the balance; serving to adjust its motions, and make it go faster or slower.

REGULUS, in chemistry, an imperfect metallic substance that falls to the bottom of the crucible in the melting of ores, or impure metallic substances.

REGULUS, in astronomy, a star of the first magnitude, in the constellation Leo; called also from its situation, corleonis, or the lion's heart.

REIN-*deer*. See CERVUS.

REJOINDER, in law, is the defendant's answer to the plaintiff's replication or reply.

RELEASE, in law, is an instrument in writing, by which estates, rights, titles, entries, actions, and other things, are extinguished and discharged; and sometimes transferred, abridged, or enlarged; and in general, it signifies one person's giving up or discharging the right he has, or claims to have, against another, or his lands, &c. A release may be either in fact or in law; a release in fact is where it is expressly declared, by the very words, as the act and deed of the party; and a release in law is that which acquits by way of consequence, as where a female creditor takes the debtor to be her husband.

RELEASE, in law. Releases are distinguished into express releases in deed, and those arising by operation of law; and are made of lands and tenements, goods and chattels, or of actions real, personal, and mixed.

RELIEF, a certain sum of money which the tenant holding by knight's service, grand serjeantry, or other tenure, for which homage or legal service is due, and being at full age at the death of his ancestor, formerly paid to his lord at his entrance.

RELIEVO, or RELIEF, in sculpture, &c. is the projecture or standing out of a figure, which arises prominent from the ground or plan on which it is formed: whether that figure be cut with the chissel, moulded, or cast.

There are three kinds or degrees of relievo, viz. alto, basso, and demi-relievo. The alto-relievo, or high relievo, is when the figure is formed after nature, and projects as much as the life. Basso-relievo, bass-relief, or low-relievo, is when the work is raised but a little from the ground, as in medals, and the frontispieces of buildings; and particularly in the histories, festoons, foliages, and other ornaments of friezes. Demi-relievo is when one half of the figure rises from the plan.

RELIGION, is a term of very extensive import, and is used by various portions of the human race to designate things, in themselves diametrically opposed to each other, while each and every one is believed to bear upon the same great object, viz. the mode or manner of expressing the high veneration which the human intellect owes to the Supreme Ruler of the universe. Hence we have the Jewish religion, the Christian religion, the Mahometan religion, the Hindoo religion, the Chinese religion, &c. &c. To tell of all these, with their numerous divisions and subdivisions, would require many volumes; suffice it to say, that wherever religion is professed, it is in the way of acknowledging a belief in a future state, of rewards and punishments according to the deeds done in the body. When this is duly considered, and when it is connected with the fact that there are not two individuals of the human race to be found who entertain precisely the same opinions on matters of faith, what an overwhelming idea seizes the mind of the unutterable variety of state that must exist in the spiritual world, and of the immensity of those heavens which, from the commencement of time, have been every moment receiving fresh accessions of inhabitants, and which will continue to do so throughout eternity itself, from the innumerable worlds that compose the boundless creation! What consummate folly is bigotry!

REMAINDER, in law, is an estate limited in lands, tenements, or rents, to be enjoyed after the expiration of another particular estate. There is this difference between a remainder and a reversion: in case of a reversion, the estate granted, after the limited time, reverts to the grantor or his heirs; but by a remainder it goes to some third person, or a stranger.

REMEMBRANCERS, anciently called clerks of the remembrance, certain officers in the exchequer, whereof three are distinguished by the names of the king's remembrancer, the lord treasurer's remembrancer, and the remembrancer of the first fruits.

REMITTER, a term in law, which implies that a person having a right is dispossessed, and then by a bad title, different from his former one, gets possession. He is then said to be remitted to his former title, or to be in by remitter, and cannot be turned out, although he gained his last possession by a bad title.

RENDEZVOUS, in a military sense, the place appointed by the general, where all the troops that compose the army are to meet at the time appointed.

RENT, is a certain profit issuing yearly out of lands and tenements corporeal. There are at common law three kinds of rents; rent service, rent charge, and rent seck. Rent service is where the tenant holds his land of his lord by fealty and certain rent; or by homage, fealty, and certain rent; or by other service and certain rent; and it is called a rent service, because it has some corporal service incident to it, which at least is fealty. Rent charge is so called because the land for payment thereof is charged with a distress. Rent seck is where the land is granted without any clause of distress for the same.

The time for payment of rent, and, consequently, for a demand, is such a convenient time before the sun-setting of the last day, as will be sufficient to have the money counted; but if the tenant meet the lessor on the land at any time of the last day of payment, and tender the rent,

that is sufficient tender, because the money is to be paid indefinitely on that day, and therefore a tender on that day is sufficient.

REPERTORY, a place in which things are orderly disposed so as to be easily found when wanted.

REPETITION, in music, denotes a reiterating or playing over again the same part of a composition, whether it is a whole strain, part of a strain, or double strain, &c.

REPLETION. See MEDICINE.

REPLEVIN, is the writ called replegiare facias by him who has cattle or other goods distrained by another, for any cause, and putting in surety to the sheriff, that upon delivery of the thing distrained, he will prosecute the action against the distrainer.

In this writ or action, both the plaintiff and defendant are called actors; the one, that is, the plaintiff, suing for damages, and the avowant or defendant to have a return of the goods or cattle.

REPLICATION, in logic, the assuming or using the same term twice in the same proposition.

REPLICATION, an exception or answer of the plaintiff in a suit to the defendant's plea; and is also that which the complainant replies to the defendant's answer in chancery, &c.

REPORT, in law, is a public relation of cases judicially argued, debated, resolved, or adjudged, in any of the king's courts of justice, with the causes and reasons of the same, as delivered by the judges.

REPRIEVE, to suspend a prisoner from the execution and proceeding of the law at that time. Every judge who has power to order any execution, has power to reprieve.

REPRISE, or REPRIZE, at sea, is a merchant-ship, which, after its being taken by a corsair, privateer, or other enemy, is retaken by the opposite party.

If a vessel thus retaken has been twenty-four hours in the possession of the enemy, it is deemed a lawful prize; but if it is retaken within that time, it is to be restored to the proprietor, with every thing in it, upon his allowing one-third to the vessel which made the reprise.

REPRODUCTION, is usually understood to mean the restoration of a thing before existing, and since destroyed. It is very well known that trees and plants may be raised from slips and cuttings; and some late observations have shewn, that there are some animals which have the same property. The polype (see POLYPUS) was the first instance we had of this; but we had scarcely time to wonder at the discovery Mr. Trembley had made, when Mr. Bonett discovered the same property in a species of water-worm. Amongst the plants which may be raised from cuttings, there are some which seem to possess this quality in so eminent a degree, that the smallest portion of them will become a complete tree again.

A twig of willow, poplar, or many other trees, being planted in the earth, takes root, and becomes a tree, every piece of which will in the same manner produce other trees. The case is the same with these worms; they are cut to pieces, and these several pieces become perfect animals, and each of these may be again cut into a number of pieces, each of which will in the same manner produce an animal.

The reproduction of several parts of lobsters, crabs, &c. is one of the greatest curiosities in natural history. It seems, indeed, inconsistent with the modern system of generation, which supposes the animal to be wholly formed in the egg; that, in lieu of an organical part of an animal cut off, another should arise perfectly like it: the fact, however, is too well attested to be denied.

If the leg of a lobster be broken off by design at the fourth or fifth articulation, what is thus broken off is always reproduced. But if the fracture be made in the first, second, or third articulation, the reproduction is not so certain. And it is very surprising, that, if the fracture be made at these articulations, at the end of two or three days, all the other articulations are generally found broken off to the fourth, which, it is supposed, is done by the creature itself, to make the reproduction certain.

REPTILIA, in natural history, an order of amphibia, the character of which is, that they breathe through the mouth; have feet, and flat naked ears without auricles. There are five genera; viz.

Draco	Siren
Lacerta	Testudo
Rana.	

REPULSION, in physics, that property in bodies, whereby, if they are placed just beyond the sphere of each other's attraction of cohesion, they mutually fly from each other. Thus, if an oily substance, lighter than water, be placed on the surface thereof, or if a piece of iron be laid upon mercury, the surface of the fluid will be depressed about the body laid on it: this depression is manifestly occasioned by a repelling power in the bodies, which hinders the approach of the fluid towards them. But it is possible, in some cases, to press or force the repelling bodies into the sphere of one another's attraction; and then they will mutually tend towards each other, as when we mix oil and water till they incorporate.

REQUESTS, *Court of*, an ancient court of equity, instituted about the nineteenth year of Henry VII.

RESCRIPT, an answer delivered by an emperor, or pope, when consulted by particular persons, on some difficult question, or point of law, to serve as a decision thereof.

RESERVE, *body of*, or *corps de reserve*, in military affairs, the third or last line of an army, drawn up for battle; so called because they are reserved to sustain the rest, as occasion requires; and not to engage, but in case of necessity.

RESIDENCE, is the continuance of a parson or vicar on his benefice.

RESIDUAL *figure*, in geometry, the figure remaining after subtracting a lesser from a greater.

RESIDUARY *Legatee*, is he to whom the residue of a personal estate is given by will; and such legatee being made executor with others, shall retain against the rest.

RESIN. The name *resin* is used to denote solid inflammable substances, of vegetable origin, soluble in alcohol, usually affording much

soot by their combustion. They are likewise soluble in oils, but not at all in water; and are more or less acted upon by the alkalis.

All the resins appear to be nothing else but volatile oils, rendered concrete by their combination with oxygen. The exposure of these to the open air, and the decomposition of acids applied to them, evidently prove this conclusion.

There are some among the known resins which are very pure, and perfectly soluble in alcohol, such as the balsam of Mecca and of Capivi, turpentines, tacamahaca, elemi: others are less pure, and contain a small portion of extract, which renders them not totally soluble in alcohol; such are mastic, sandarach, guaiacum, labdanum, and dragon's blood.

RESISTANCE, or **Resisting** *force*, in philosophy, denotes, in general, any power which acts in an opposite direction to another, so as to destroy or diminish its effect. Hence the force wherewith bodies, moving in fluid mediums, are impeded or retarded, is the resistance of those fluids.

RESOLUTION, or **Solution**, in mathematics, is an orderly enumeration of several things to be done, to obtain what is required in a problem.

Resolution, in algebra, or *algebraical resolution*, is of two kinds; the one practised in numerical problems, the other in geometrical ones.

Resolution, in chemistry, &c. the reduction of a mixed body into its component parts, or first principles, by a proper analysis. The resolution of bodies is effected by divers operations, as distillation, sublimation, fermentation, precipitation, &c.

RESPIRATION. A function of animals, which consists in the alternate inhalation of a portion of air into an organ called the lungs, and its subsequent exhalation. The venous blood, which enters the lungs from the pulmonary artery, is charged with carbon, to which it owes its dark purple colour. When the atmospherical oxygen is applied to the interior of the air vesicles of the lungs, it combines with the carbon of the blood, forms carbonic acid, which to the amount of from 4.5 to 8 per cent of the bulk of air inspired, is immediately exhaled. It does not appear that any oxygen or azote is absorbed by the lungs in respiration; for the volume of carbonic acid generated, is exactly equal to that of the oxygen which disappears. Now, we know that carbonic acid contains its own volume of oxygen. It is probable that the quantity of carbonic acid, produced in the lungs, varies in different individuals, and in the same individual under different circumstances. The change of the blood, from the purple venous to the bright red arterial, seems owing to the discharge of the carbon. An ordinary sized man consumes about 46 thousand cubic inches of oxygen *per diem*; equivalent to 125 cubic feet of air. He makes about 20 respirations in a minute; or breathes twice, for every seven pulsations. Dr. Prout and Dr. Fyfe found, that after swallowing intoxicating liquors, the quantity of carbonic acid formed in respiration was diminished. The same thing happens under a course of mercury, nitric acid, or vegetable diet.

REST, the continuance of a body in the same place, or its continual application or contiguity to the same parts of the ambient or contiguous bodies; and therefore is opposed to motion. Sir Isaac Newton defines true or absolute rest to be the continuance of a body in the same part of absolute space; and relative rest to be the continuance of a body in the same part of relative space.

RETAINER *of debts*, an executor, among debts of equal degree, may pay himself first, by retaining in his hands, the amount of his debt.

RETARDATION, in physics, the act of diminishing the velocity of a moving body. If bodies of equal bulk, but of different densities, be moved through the same resisting medium, with equal velocity, the medium will act equally on each, so that they will have equal resistances; but their motions will be unequally retarded, in proportion to their densities.

RETICULA, or **Reticule**, in astronomy, a contrivance for the exact measuring the quantity of eclipses.

RETINA, in anatomy, the expansion of the optic nerve on the internal surface of the eye, whereupon the images of objects being painted, are impressed, and by that means conveyed to the common sensory in the brain, where the mind views and contemplates their ideas. See **Optics**.

RETORT, in chemistry, a kind of hollow spherical vessel. See **Laboratory**.

RETRENCHMENT, in the art of war, any kind of work raised to cover a post, and fortify it against the enemy.

RETROGRADATION, or **Retrogression**, the act or effect of a thing moving backwards.

The retrograde motion of the planets is an apparent motion, whereby they seem, to an observer placed on the earth, to move backwards, or contrary to the signs.

REVE, **Reeve**, or **Greve**, the bailiff of a franchise, or manor, thus called, especially in the west of England. Hence shire-reve, sheriff, port-greve, &c.

REVEILLE, a beat of drum about break of day, to give notice that it is time for the soldiers to arise, and that the sentries are to forbear challenging.

REVELATION, is a term used to denote that collection of writings which we call the Bible, that is **the book**, by way of eminence, comprehending a great number of different narratives and compositions, written at different times by different persons, in different languages, and on different subjects. That these books were all composed by those whose names they bear, there is not the least reasonable ground to doubt; they have been always considered as the writings of those persons by the whole Jewish nation, who were most interested in their authenticity, and most likely to know the truth, from the earliest times down to the present: and no proof to the contrary has ever yet been produced.

The Jews were always remarkable for being the faithful guardians of that divine deposit, which they transcribed repeatedly, and compared most carefully with the originals, and of which it is well known, they even numbered the words and letters. Indeed the very Messiahship of Jesus is proved from those very books, which they have preserved.

Taking the whole of the Scriptures together it is an unquestionable truth, that there is no one book extant, in any language, or in any

country, which can in any degree be compared with it for antiquity, for authority, for the importance, the dignity, the variety, and the curiosity of the matter it contains. See INSPIRATION.

REVENUE, PUBLIC, the yearly income appropriated to the expences of government. There are four different sources of public revenue: 1. The income derived from property vested in the public. 2. The emoluments of lucrative prerogatives annexed to the sovereignty. 3. Voluntary contributions from the people. 4. Taxes or imposts, not spontaneously given, but legally exacted. From one or other of these great sources all public revenue must arise.

REVERSION, a sum of money, estate, annuity, or any other kind of property, the possession of which is not to be obtained till after the expiration of a certain period of time, or till some event, as the failure of a life or lives, has happened. The present value of such property depends greatly on the current interest of money, for if money produced only 3 per cent. interest, a person giving 1000*l.* for a reversionary estate relinquishes an annuity of 30*l.*, but if he could make 5 per cent. interest of his money, he gives up an annuity of 50*l.*, and consequently in the latter case he would expect a greater reversion than the former. The true value of a reversion, therefore, is that present sum which if improved at a given rate of interest, would at the period when the reversion comes into possession amount to its then actual value. This, with respect to sums receivable at the end of a certain number of years, is easily found by any correct interest table.

REVIEW, in chancery, is used for a bill where a cause has been heard, and a decree thereon signed; but some error in law appearing upon the decree, or new matter being discovered after it was made, this bill is given for a fresh examination into the merits of the cause.

REVIEW, in war, is the appearance of a army, or part of an army, in order of battle, and their being viewed by the general, that he may know the condition of the troops.

REVIEW, is also the name of one kind of periodical publications, now too much prostituted (under the shelter of anonymous criticism) to the purposes of the malice of rival authors, and the petty artifice of interested booksellers.

REVIVOR, *bill of*, in chancery, is a bill for reviving a cause, where either of the parties dies after the bill and answer, and before the cause is heard; or if heard, before the decree is inrolled; in which case this bill must be brought, praying that the former proceeding may stand revived, and be put upon the same footing as at the time of the abatement.

REVOCATION, in law, signifies the recalling or annulling and making void, some power, grant, deed, &c. made before.

RHAPIS, a genus of the monogynia order, in the hexandria class of plants; and in the natural method ranking under the first order palmæ.

RHEA, *Americana*, the American ostrich, in size, is very little inferior to the common one; the bill is sloped, not unlike that of a goose, being flat at the top, and rounded at the end; the eyes are black, and the lids furnished with hairs; the head is rounded, and covered with downy feathers; the neck is two feet eight inches long, and feathered also: from the tip of one wing to that of the other extended, the length is eight feet; it cannot fly, but it runs very swiftly; the legs are stout, and bare of feathers above the knees, and furnished with three toes, all placed forwards, each having a straight and stout claw as in the cassowary; on the heel is a callous knob, serving in the place of a back toe; the general colour of the plumage is dull grey mixed with white, inclining to the latter on the under parts; the tail is very short, and not conspicuous, being entirely covered with long, loose, and floating feathers, having its origin from the lower part of the back and rump, and entirely covering it; the bill and legs are brown.

RHETORIC, in the most extensive sense of the word, denotes the art of composition, or that which enables us to apply language or speech to the best possible advantage. According to etymology, which often affords the most satisfactory explanation of words, it signifies the art of pouring forth a stream of sentiment, and communicating with fluency our feelings and thoughts to others. It is derived from the Greek ῥέω, *to speak*; and this again from ῥέω, *to flow*, or *run like a river.*

Taken in this point of view, rhetoric will comprehend all polite literature, poetry perhaps excepted, the belles-lettres of the French, the pathetic and pleasant of every kind; compositions whose aim and end is not so much to inform or satisfy the understanding, as to move, incline, and persuade, by addressing the imagination, the affections, and, in some measure, sensation itself.

There cannot be a better rule for composition, or one more plain and practical than is laid down by Cicero: "We are first to consider what is to be said; secondly, how; thirdly, in what words; and, lastly, how it is to be ornamented."

RHEUM, a thin serous humour, occasionally oozing out of the glands about the mouth and throat.

RHEUM, *rhubarb*, a genus of the monogynia order, in the enneandria class of plants, and in the natural method ranking under the 12th order, holoraceæ. There is no calyx; the corolla is sexfid and persistent; and there is one triquetrous seed.

There are seven species, among which the principal is the *R. palmatum*, officinal rhubarb: the root is perennial, thick, of an oval shape, sending off long tapering branches externally it is brown, internally of a deep yellow colour; stem erect, round, hollow, jointed, from six to eight feet in height; root leaves numerous, large, rough, of a roundish figure, deeply cut into lobes, and irregularly pointed segments; on long foot-stalks; stem leaves one at each joint, from a membranaceous sheath, successively smaller upwards; flowers surrounding the branches in numerous clusters forming a kind of spike; corolla of a greenish white colour It is a native of China and Tartary. At the end of six or seven years, when the plant seems to arrive at its most perfect state, one pound of rhubarb may be obtained from every five pounds of the green roots, besides an equal or larger proportion of roots fit for family use.

RHINOCEROS, a genus of quadrupeds of the order belluæ: the generic character is, horn solid, perennial, conical, seated on the nose.

1. Rhinoceros unicornis, single-horned rhinoceros. The rhinoceros is the largest of land animals, the elephant alone excepted. It is of a highly uncouth and awkward form. The back, instead of rising, as in the elephant, sinks in considerably: the head is moderately large and long; the upper lip protrudes or hangs over the lower in the form of a lengthened tip; and, being extremely pliable, answers the end of a small proboscis, and is useful to the animal in catching hold of the shoots of vegetables, &c. and delivering them into the mouth. On the nose is situated a very strong, slightly curved, sharp-pointed horn, which, in the full-grown animal, is sometimes three feet in length, and eighteen inches in circumference at the base.

The rhinoceros is a native of several parts of India, as well as of the islands of Java, Sumatra, &c. This animal falls far short of the elephant in sagacity and docility. It is, however, of a quiet and inoffensive disposition, but very furious and dangerous when provoked or attacked: he is said to run with great swiftness, and, from his strength and impenetrable covering, is capable of rushing with resistless violence through woods and obstacles of every kind; the trees bending like twigs while he passes between them.

2. Rhinoceros bicornis, the two-horned rhinoceros, is found in various parts of Africa, and seems to have been the kind which was known to the ancient Romans, and by them exhibited in their public shows and combats of animals. In size it equals the common or single-horned species; and its habits and manner of feeding are the same; but it differs greatly in the appearance of its skin, which, instead of the vast and regularly marked armour-like folds of the former, has merely a very slight wrinkle across the shoulders, and on the hinder parts with a few fainter wrinkles on the sides, so that, in comparison with the common rhinoceros, it appears almost smooth; the skin, however, is rough or tuberculated, especially in the larger specimens; but what constitutes the specific or principal distinction is, that the nose is furnished with two horns, one of which is smaller than the other, and situated above it, or higher up on the front.

RHINOMACER, in natural history, a genus of insects of the order coleoptera. Antennæ setaceous, seated on the snout; four feelers, growing thicker towards the end, the last joint truncate. There are three species, found in Italy and Sweden.

RHODIUM. See Chemistry.

RHODIOLA, *rose-wort*, a genus of the octandria order, in the diœcia class of plants, and in the natural method ranking under the 13th order, succulentiæ. There are two species, the rosea and the biternata; the first grows naturally in the clefts of the rocks and rugged mountains of Wales, Yorkshire, and Westmorland.

RHOIMBOIDES. See Geometry.

RHOMBOS. See Geometry.

RHUBARB. See Rheum.

RHUMB, in navigation, a vertical circle of any given place, or the intersection of such a circle with the horizon; in which last sense rhumb is the same with a point of the compass.

Rhumb-line, is also used for the line which a ship describes when sailing in the same collateral point of the compass, or oblique to the meridians.

RHUS. See Sumach.

RHYME. See Poetry.

RHYTHMICAL, in music, an epithet applied to the property or quality, in the ancient melopœia and modern melody, by which the cadences, accents, and quantities, are regulated and determined.

RIBBAND, or Ribbon, a narrow sort of silk, chiefly used for head-ornaments, badges of chivalry, &c.

RIBES, the *currant* and *gooseberry-bush*, a genus of the monogynia order, in the pentandria class of plants, and in the natural method ranking under the 36th order, pomaceæ. There are seventeen species, viz. ten of the currant, and seven of the gooseberry; all these shrubs are too well known to need a particular description in this work.

RICINUS, or Palma Christi, a genus of the monadelphia order, in the monœcia class of plants, and in the natural method ranking under the 38th order, tricoccæ. There are six species, of which the most remarkable is the communis, or common palma christi.

RIDE, in the sea language, is a term variously applied: thus, a ship is said to ride, when her anchors hold her fast, so that she does not drive by the force either of the wind or tide.

RIDERS, in a ship, are large timbers, both in the hold and aloft, bolted on to other timbers to strengthen them, when the ship is discovered to be too slightly built.

RIDING-CLERK, one of the six clerks in chancery, who, in his turn, annually keeps the controlment-books of all grants that pass the great seal that year.

RIFLE, a fire-arm which has the inside of its barrel cut with from three to nine or ten spiral grooves, so as to make it resemble a female screw, varying from a common screw only in this, that its grooves or rifles are less deflected, and approach more to a right line; it being now usual for the grooves with which the best rifled barrels are cut, to take about one whole turn in a length of thirty inches. The number of these grooves differs according to the size of the barrel and fancy of the workman; and their depth and width are not regulated by any invariable rule.

RIGGING *of a ship*, is all her cordage and ropes, belonging to her masts, yards, &c. A ship is said to be well rigged, when all her ropes are of a fit size and proportion: and she is said to be over-rigged, when her ropes are too large, which is of great prejudice to her sailing, and is apt to make her heel.

RIGHT, in geometry, signifies the same with straight: thus, a straight line is called a right one.

Right, in general signification, includes not only a right, for which a writ of right lies, but also any claim or title, either by virtue of a condition, mortgage, or the like, for which no action is given by law, but only an entry.

RING, in astronomy and navigation, an instrument used for taking the sun's altitude, &c. It is usually of brass, about nine inches diameter, suspended by a little swivel, at the

distance of 45° from the point of which is a perforation, which is the centre of a quadrant of 90 degrees divided in the inner concave surface.

RIOT, in law. When three persons or more shall assemble themselves together with an intent mutually to assist one another, against any who shall oppose them in the execution of some enterprize of a private nature, with force or violence against the peace, or to the manifest terror of the people, whether the act intended was of itself lawful or unlawful: if they only meet for such a purpose or intent, though they shall after depart of their own accord without doing any thing, this is an unlawful assembly.

It is enacted, that if a justice find persons riotously assembled, he alone has not only power to arrest the offenders, and bind them to their good behaviour, or imprison them if they do not offer good bail; but he may also authorize others to arrest them, by a bare verbal command, without other warrant; and by force thereof, the persons so commanded may pursue and arrest the offenders in his absence as well as presence. It is also said, that after any riot is over, any one justice may send his warrant to arrest any person who was concerned in it, and that he may send him to gaol till he shall find sureties for his good behaviour.

By the act 1 George II. st. 2, c. 5, every justice, mayor, sheriff, &c. shall upon notice of a riot, or unlawful, tumultuous assembly of twelve persons, proceed to the place, and make proclamation for them to depart, upon the pains of that act, commonly called the riot act. If any person shall wilfully oppose or hurt any person going to make proclamation, and prevent the same, he shall be guilty of felony, without benefit of clergy. If twelve continue together after proclamation, for one hour, it is felony in like manner. And every justice, &c. shall apprehend persons, and if the rioters are killed, the justice, &c. shall not answer for it. A riot though of fewer persons than twelve, to destroy any church, chapel, meeting, or dwelling-house, out-house, &c. is a capital felony: and the hundred shall answer the damages, as in case of robbery.

If two justices go out to quell a riot, may assemble the *posse comitatus*, and every person capable of travelling is, upon being warned, to join them, on pain of imprisonment.

RITE, among divines, denotes the particular manner of celebrating divine service, in a particular country.

RITUAL, a book directing the order and manner to be observed in celebrating religious ceremonies, and performing divine service in a particular church, diocese, order, or the like.

RIVER, a current, or stream of fresh water, flowing in a bed or channel, from its source into the sea. When a stream is not large enough to bear boats, or small vessels laden, it is called a rivulet or brook. The great as well as the middle-sized rivers, proceed either from a confluence of brooks and rivulets, or from lakes; but no river of magnitude flows from one spring, or one lake, but is augmented by the accession of others.

ROACH. See CYPRINUS.

ROAD in navigation, is a place of anchorage at some distance from shore, where vessels usually moor, to wait for a wind or tide proper to carry them into harbour, or to set sail.

ROASTING, in metallurgy, the separation of volatile bodies from those which are more fixed, by the combined action of air and fire; and is generally the first process in the separation of metals from their ores.

ROBBERY, is a felonious taking away of another man's goods from his person, or presence, against his will, putting him in fear, on purpose to steal the same. The value is immaterial.

If a man force another to part with his property, for the sake of preserving his character from the imputation of having been guilty of an unnatural crime, it will amount to a robbery, even though the party was under no apprehension of personal danger. If any thing is snatched suddenly from the head, hand, or person of any one, without any struggle on the part of the owner, or without any evidence of force, or violence being exerted by the thief, it does not amount to robbery. But if any thing be broken or torn in consequence of the sudden seizure, it would be evidence of such force as would constitute a robbery: as where a part of a lady's hair was torn away by snatching a diamond pin from her head, and an ear was torn by pulling off an ear-ring; each of these cases was determined to be a robbery

Highway-robbery differs from robbery only in this, that there is a reward of 40*l*. for the apprehending of the offender, and the horse which the robber rides is forfeited.

ROBINSONIA, a genus of the icosandria monogynia class and order. The cal. is five-toothed; pet. five; berry striated, two-celled; cells one seeded; seeds villose. There is one species, a tree of Guiana.

ROCK, a stony mass, forming a portion of the substance of this globe. Rocks are in general disposed in mountanic ranges; but in some few instances are found existing in immensely larges separate masses. See GEOLOGY.

ROCKET. See PYROTECHNY.

ROD, a land measure of sixteen feet and a half, and is the same with perch and pole.

ROE, the spawn or seed of fish. That of male fishes is usually distinguished by the name of soft-roe, or milt, and that of the female, by hard roe, or spawn.

ROLL, in manufactories, something wound and folded up in a cylindrical form.

Few stuffs are made up in rolls, except ttins, gauses, and crapes, which are apt to break, and take plaits not easy to be got out, if folded otherwise.

ROLL, in law, signifies a schedule or parchment which may be rolled up by the hand into the form of a pipe.

In these schedules of parchment all the pleadings, memorials, and acts of court, are entered and filed by the proper officer: which being done, they become records of the court.

ROLLING *mill*, in mechanics, a machine for working metals into plates, or bars, which are required of an even thickness.

Rolling mills are chiefly used for drawing out iron bars after they have been manufactured into bar iron by the forge hammer; the rollers leave a smoother surface, and make a

bar of more even thickness than the hammer can be made to do.

ROMAN *Catholics*, in church history, a name given to those christians who believe the doctrines, and submit to the discipline of the church of Rome.

ROOD, a quantity of land equal to forty square perches, or the fourth part of an acre.

ROOK, in ornithology. See CORVUS.

ROOT, in mathematics, a quantity considered as the basis or foundation of a higher power; or one which being multiplied into itself any number of times, produces a square, cubic, biquadratic, &c. quantity; called the second, third, fourth, &c. power of the root, or quantity so multiplied into itself.

ROPE, hemp, hair, &c. spun into a thick yarn, and then several strings of this yarn twisted together by means of a wheel. When made very small, it is called a cord, and when very thick, a cable. All the different kinds of this manufacture, from a fishing line, or whipcord, to the cable of a first-rate ship of war, go by the general name of cordage. Ropes are made of every substance that is sufficiently fibrous, flexible, and tenacious, but chiefly of the inner barks of plants.

ROPE *making*, is an art of very great importance; and there are few that better deserve the attention of the intelligent observer. Hardly any art can be carried on without the assistance of the rope-maker. Cordage makes the very sinews and muscles of a ship; and every improvement which can be made in its preparation, either in respect to strength or pliableness, must be of immense service to the mariner, and to the commerce and defence of nations.

ROSA, the *rose*, a genus of the polygynia order, in the icosandria class of plants, and in the natural method ranking under the 35th order, senticosæ. The sorts of roses are very numerous; and the botanists find it very difficult to determine with accuracy which are species and which are varieties.

ROSMARINUS, *rosemary*, a genus of the monogynia order, in the diandria class of plants, and in the natural method ranking under the 42d order, verticillatæ. There are two species the officianalis and chilensis.

ROTACEÆ, in botany, the name of the twentieth order in Linnæus's Fragments of a natural method, consisting of plants with one flat, wheel-shaped petal.

ROTATION, in geometry, a term chiefly applied to the circumvolution of any surface round a fixed and immoveable line, which is called the axis of its rotation; and by such rotations it is, that solids are conceived to be generated.

ROTTEN-STONE, a mineral found in Derbyshire, and used by mechanics for all sorts of finer grinding and polishing, and sometimes for cutting of stones. According to Ferber, it is a tripoli mixed with calcareous earth.

ROUND, in a military sense, signifies a walk which some officer, attended with a party of soldiers, takes in a fortified place around the ramparts in the night-time, in order to see that the centries are watchful, and every thing in good order.

RUBRIA. See MADDER.

RUBRIC, in the canon law, signifies a title or article in certain ancient law books; thus called because written, as the titles of the chapters in our ancient bibles are, in red letters. Rubrics also denote the rules and directions given at the beginning, and in the course of the liturgy, for the order and manner in which the several parts of the office are to be performed.

RUBUS, the *bramble*, a genus of the polygamia order, in the icosandria class of plants; and in the natural method ranking under the 35th order, senticosæ. The principal species is the idæus, or common raspberry, which, with its varieties, demands culture in every garden for their fruit; particularly the common red kind, white sort, and twice bearing raspberry; all of which are great bearers; but for the general plantations, we choose principally the common red and the white kind, as being generally the greatest bearers of all.

RUBY. See CORUNDUM.

RUDDER, in navigation, a piece of timber turning on hinges in the stern of the ship, and which, opposing sometimes one side to the water, and sometimes another, turns or directs the vessel this way or that.

RULE, or *Ruler*, an instrument of wood or metal, with several lines delineated on it, of great use in practical mensuration.

Various forms of the sliding rule have from time to time appeared; that which is used by the officers of the excise is certainly good, but it is cumbersome for the pocket. By far the best and most convenient instrument of this kind that we have seen is that lately invented by Mr. Bevan, civil engineer, who has also published a small treatise to accompany the rule. The operative mechanic will find these of immense service in making his calculations; indeed this rule is highly useful in every department of the common business of life.

RULES *of court*, in law, are certain orders made, from time to time, in the courts of law, which attornies are bound to observe, in order to avoid confusion; and both the plaintiff and defendant are at their peril also bound to pay obedience to rules made in court relating to the cause depending between them.

RUM, a species of brandy or vinous spirits distilled from sugar-canes.

RUMEN, in comparative anatomy, the paunch, or first stomach of such animals as chew the cud, thence called ruminant animals.

RUMMAGE, in the sea-language, signifies to clear a ship's hold, or to remove goods from one place of it to another.

RUNDLET, or **RUNLET**, a small vessel containing an uncertain quantity of any liquor; from three to twenty gallons.

RUNIC, a term applied to the language and letters of the ancient Goths, Danes, and other northern nations.

RUNNER, in the sea-language, a rope belonging to the garnet, and to the two bolt-tackles.

RUNNET, or **RENNET**, the acid juice found in the stomachs of calves that have fed on nothing but milk, and are killed before the digestion is perfect.

RUPERT'S *drops*, a sort of glass-drops with long and slender tails, which burst to pieces on the breaking off those tails in any part, said to have been invented by Prince

Rupert, and therefore called after his name. This surprising phenomenon is supposed to rise from hence, that while the glass is in fusion, or in a melted state, the particles of it are in a state of repulsion; but being dropped into cold water, it so condenses the particles in the external parts of their superficies, that they are easily reduced within the power of each other's attraction, and by that means they form a sort of hard case, which keeps confined the before-mentioned particles in their repulsive state; but when this outer-case is broken, by breaking off the tail of the drop, the said confined particles have then a liberty to exert their force, which they do by bursting the body of the drop, and reducing it to a very peculiar form of powder.

RUST, a word signifying the oxide of a metal. Iron, for instance, when exposed to the air, soon becomes tarnished, and gradually changed into a brown or yellow powder, well known by the name of rust.

RUSTIC, in architecture, implies a manner of building in imitation of nature, rather than according to the rules of art.

RUTA, *rue*, a genus of the monogynia order in the decandria class of plants; and in the natural method ranking under the 26th order, multisiliquæ. There are seven species, of which the most remarkable is the hortensis, or common broad-leaved garden rue, which has been long cultivated for medicinal use.

RYANIA, a genus of the polyandria monogynia class and order. The calyx is five-leaved, corolla none; stigmas four; berry suberous, one-celled, many-seeded. There is one species, a tree of Trinidad.

RYE. See SECALE.

S.

S, the eighteenth letter of our alphabet. Used as a numeral, S. anciently denoted seven; in the Italian music, S. signifies solo; and in books of navigation, S. stands for south; S. E. for south-east; S. W. for south-west; S. S. E. for south south east; S. S. W. for south-south-west.

SABBATARIANS, a sect of Christians, chiefly Baptists, who observe the Jewish or Saturday Sabbath, from a persuasion that, it being one of the ten commandments, which they contend are all in their nature moral, was never abrogated by the New Testament.

SABELLIANS, a sect of Christians of the third century, who embraced the opinions of Sabellius, a philosopher of Egypt, who openly taught that there is but one person in the Godhead.

SABLE. See MUSTELA.

SABRE, a kind of sword, or scimetar, with a very broad and heavy blade, thick at the back, and a little falcated, or crooked towards the point. It is generally worn by the heavy cavalry and dragoons.

SACCHARUM, *sugar*, or the *sugar-cane*, a genus of the digynia order, in the triandria class of plants; and in the natural method ranking under the fourth order, gramina. The calyx is two-valved; the corolla is also bivalved. There are eleven species; among which we shall notice the S. officinarum, common sugar-cane, the root of this plant is jointed, like that of other sorts of cane, or reed; from this root arise four, five, or more shoots, proportionable to the age or strength of the root, eight or ten feet high according to the goodness of the ground; in very good rich soils, canes have been measured nearly twenty feet in height, these are not so much esteemed as those of a middling growth, abounding in juice, and having little of the essential salt.

SACK *of wool*, a quantity of wool containing just twenty-two stones, and every stone fourteen pounds In Scotland, a sack is twenty-four stone, each stone containing sixteen pounds.

SACKBUT, a musical instrument of the wind kind, being a sort of trumpet, though different from the common trumpet both in form and size: it is fit to play a bass, and is contrived to be drawn out, or shortened, according to the tone required, whether grave or acute.

SACKS *of earth*, in fortification, are canvas-bags filled with earth. They are used in making intrenchments in haste, to place on parapets, or the head of the breaches, &c. to repair them, when beaten down.

SACLACTIC ACID. This acid was discovered by Scheele in 1780. After having obtained oxalic acid from sugar, he wished to examine whether the sugar of milk would furnish the same product.

Saclactic acid may be obtained by the following process: Upon one part of gum arabic, or other similar gum, previously put into a retort, pour two parts of nitric acid. Apply a slight heat for a short time, till a little nitrous gas and carbonic acid gas comes over; then allow the mixture to cool. A white powder gradually precipitates, which may easily be separated by filtration. This powder is saclactic acid.

SACRILEGE, is church robbery, or a taking of things out of an holy place, as where a person steals any vessels, ornaments, or goods of the church.

SADDLE, is a seat upon a horse's back, contrived for the conveniency of the rider. The ancient Romans are supposed not to have made use of saddles and stirrups, and it is thought that they did not come into use till the time of Constantine the Great, A D 340.

SAFETY-*lamp*, is a lamp used by those who are employed in coal mines; its construction is such that a miner may move about with it, and even work by its light in the midst of those explosive mixtures which have so often proved fatal when entered with a common lamp, or a candle. This excellent invention belongs to Sir H. Davy, and is thus briefly described by Dr. Ure.

The safety lamp transmits its light, and is fed with air, through a cylinder of iron or copper wire-gauze; and this fine invention has the advantage of requiring no machinery, no philosophical knowledge to direct its use, and is made at a very cheap rate

The apertures in the gauze should not be more than $\frac{1}{20}$ of an inch square. As the fire-damp is not inflamed by ignited wire, the thickness of the wire is not of importance, but wire from $\frac{1}{40}$ to $\frac{1}{60}$ of an inch in diameter is the most convenient.

The parts of the lamp are,

1. The brass cistern which contains the oil, pierced near the centre with a vertical narrow tube, nearly filled with a wire which is recurved above, on the level of the burner, to trim the wick, by acting on the lower end of the wire, with the fingers. It is called the safety-trimmer.
2. The rim, in which the wire-gauze cover is fixed, and which is fastened to the cistern by a moveable screw.
3. An aperture for supplying oil, fitted with a screw or a cork, and which communicates with the bottom of the cistern by a tube; and a central aperture for the wick.
4. The wire gauze cylinder, which should not have less than 625 apertures to the square inch.
5. The second top $\frac{3}{4}$ of an inch above the first, surmounted by a brass or copper plate, to which the ring of suspension is fixed.
6. Four or six thick vertical wires, joining the cistern below with the top plate, and serving as protecting pillars round the cage.

When the wire-gauze safe-lamp is lighted and introduced into an atmosphere gradually mixed with fire-damp, the first effect of the fire-damp is to increase the length and size of the flame. When the inflammable gas forms as much as $\frac{1}{12}$ of the volume of the air, the cylinder becomes filled with a feeble blue flame, but the flame of the wick appears burning brightly within the blue flame, and the light of the wick augments till the fire-damp increases to $\frac{1}{6}$ or $\frac{1}{5}$, when it is lost in the flame of the fire-damp, which in this case fills the cylinder with a pretty strong light. As long as any *explosive* mixture of gas exists in contact with the lamp, so long it will give light, and when it is extinguished, which happens when the foul air constitutes as much as $\frac{1}{3}$ of the volume of the atmosphere, the air is no longer proper for respiration; for though animal life will continue where flame is extinguished, yet it is al [illegible] with suffering. By fixing a coil of platinum wire above the wick, ignition will continue in the metal when the lamp itself is extinguished, and from the ignited wire the wick may be again rekindled, on going into a less inflammable atmosphere.

SAFFRON. See Crocus.

Saffron is cultivated in fields for use, and no where raised with so much success as in England, the English saffron being generally allowed to be greatly superior to any other.

SAGITTA, in astronomy, the *arrow*, or *dart*, a constellation of the northern hemisphere, near the eagle, consisting of five stars, according to Ptolemy and Tycho; but in Mr. Flamsteed's catalogue, of no less than twenty-three.

SAGITTARIUS, the *archer*, in astronomy, the ninth *sign of the zodiac*. See Astronomy.

SAGO, a simple brought from the East Indies, of considerable use in diet as a restorative. It is produced from the pith of a kind of palm which grows in the East Indies, called the cycas circinalis.

SALE *of goods*. If a man agrees for the purchase of goods, he shall pay for them before he carries them away, unless some term of credit is expressly agreed upon.

If a man upon the sale of goods, warrants them to be good, the law annexes to this contract a tacit warranty, that if they be not so, he shall make compensation to the purchaser; such warranty, however, must be on the sale. But if the vender knew the goods to be unsound, and has used any art to disguise them, or if in any respect, they differ from what he represents them to be to the purchaser, he will be answerable for their goodness, though no general warranty will extend to those defects that are obvious to the senses.

SALIENT. See Fortification.

SALIVA. The fluid secreted in the mouth, which flows in considerable quantity during a repast, is known by the name of saliva.

SALIVATION. See Medicine.

SALIX, the *willow*, a genus of the diandria order, in the diœcia class of plants, and in the natural method ranking under the 50th order, amentaceæ. There are 53 species.

SALMO, the *salmon*, in natural history, a genus of fishes of the order abdominales. Generic character: head smooth, compressed; tongue white and cartilaginous; teeth in the jaws and on the tongue; gill-membrane from four to twelve-rayed; body furnished at the hind part with an adipose fin. Gmelin enumerates fifty-five species, and Shaw sixty-two, of which the following are the principal:

S. salar, or the common salmon. This abounds principally in the Northern Seas, which it quits at particular periods, to ascend rivers to a very considerable height, and deposit its spawn in them.

This fish is remarkable for the excellence of its flavour, and its richness, and is a welcome dish at every table. It constitutes, also, an important article of commerce. The principal fishery for salmon, in this island, is at Berwick on the Tweed.

S. fario, or common trout, is found in almost all the European streams, at least such as are cool and clear. Its length, in general, is about fourteen inches.

S. thymallus, or the grayling, is about a foot and a half long, and abounds in the rivers of mountainous countries in Europe and Asia. It resembles the trout in form. In some of the rivers of England, it is found in great perfection.

SALT, *common*. The preparation of that kind of salt which is used for culinary and œconomical purposes, (muriat of soda,) depends upon the well-known fact, that the salt contained in the sea-water, or brine-springs, being a fixed body, will not rise with the vapour of the water. All therefore, that is wanted, is to expose any water containing salt to evaporation. The salt commonly known by the name of bay-salt is obtained from the water of the sea by evaporation. This evaporation is in some places performed by the heat of the sun, the water being let into shallow trenches, in order to expose as large a surface as possible.

In the northern countries, where the heat of the sun is not sufficiently great, artificial fires are employed. In some salt-works these two methods are united; and in England, and

countries where salt-rock is plentiful, that substance is dissolved in salt water, and then evaporated.

SAMBUCUS, *elder*, a genus of the trigynia order, in the pentandria class of plants, and in the natural method ranking under the 43d order dumosæ. The calyx is quinquepartite; the corolla quinquefid; the berry trispermous. The species are only five.

SAMIELS, the Arabian name of a hot wind, peculiar to the desert of Arabia. It blows over the desert in the months of July and August from the north-west quarter, and sometimes it continues with all its violence to the very gates of Bagdad, but never affects any body within the walls.

SAND, in natural history, a genus of fossils, the characters of which are, that they are found

appear regular, though more or less complete concretions; not to be dissolved or disunited by water, or formed into a coherent mass by means of it, but retaining their figure in it; transparent, vitrifiable by extreme heat, and not dissoluble in, nor effervescing with, acids.

Sand is of great use in the glass manufacture; the white writing sand being employed for making of the white glass, and a coarse greenish-looking sand for the green glass. In agriculture it seems to be the office of sands to make unctuous earths fertile, and fit to support vegetables, &c.

SANDARIC GUM. A resin in yellowish-white tears, possessing a considerable degree of transparency.

SANDIVER, or GLASS-GALL. This is a saline matter, which rises as a scum in the pots or crucibles in which glass is made.

SANHEDRIM, or SANHEDRIN, among the Jews, the great council of the nation, consisting of seventy senators, taken partly from among the priests and levites, and partly out of the inferior judges, who formed what was called the lesser sanhedrim.

SANIDIUM, in natural history, the name of a genus of fossils of the class of the selenitæ, but neither of the rhomboidal nor columnar kinds, nor any other way distinguishable by its external figure, being made up of several plain flat plates.

SANIES, in medicine, a serous putrid matter, issuing from wounds; it differs from pus, which is thicker and white.

SAP. The sap of trees, chemically considered, is a watery mucilaginous liquid, often strongly saccharine, so as to yield a large quantity of sugar, and to furnish a very strong fermented liquor.

SAP, or *Sapp*, in the art of war, is the digging deep under the earth of the glacis, in order to open a covered passage into the moat.

SAP-*colours*, a name given to various expressed juices of a viscid nature, which are inspissated by slow evaporation for the use of painters; as sap-green, gamboge, &c.

SAPPHIRE. See CORUNDUM.

SARCASM, in rhetoric, a keen bitter expression, which has the true point of satire, by which the orator scoffs and insults his enemy: such was that of the Jews to our Saviour, "He saved others, himself he cannot save."

SARCOCOL, in chemistry, a gum resin, supposed to be the product of the penæa sarcocolla. It is brought from Persia and Arabia, in the form of small grains: they have sweet and bitterish taste, and are very soluble in water.

SARDONYX, a precious stone consisting of a mixture of the chalcedony and carnelian, sometimes in stiata, but at other times blended together.

SARMENTOSÆ, the name of the 11th class in Linnæus's Fragments of a Natural Method, consisting of plants which have climbing stems and branches, that, like the vine, attach themselves to the bodies in their neighbourhood for the purpose of support.

SARSAPARILLA, in pharmacy, the root of the rough smilax of Peru, consisting of a

or thicker, flexible, and composed of fibres running their whole length: they have a bitterish but not ungrateful taste, and no smell: and as to their medicinal virtues, they are sudorific and attenuant, and should be given in decoction, or by way of diet-drink.

SASH, a mark of distinction, which in the British service is generally made of crimson silk for the officers, and of crimson mixed with white cotton for the serjeants. It is worn round the waist in most regiments; in some few, particularly in the Highland corps, it is thrown across the shoulder.

SASSAFRAS, the wood of an American tree. See LAURUS.

It is said to be warm, aperient, and corroborant; and frequently employed as an infusion, in the way of tea, is a very pleasant drink: its oil is very fragrant, and possesses most of the virtues of the wood.

SATELLITE. See ASTRONOMY.

SATIN, a glossy kind of silk stuff, the warp of which is very fine, and stands out so as to cover the coarser woof. Some satins are quite plain, others wrought; some flowered with gold or silver, and others striped, &c.

SATIN SPAR. Fibrous limestone; which see.

SATURATION. Some substances unite in all proportions. Such, for example, are acids in general, and some other salts with water; and many of the metals with each other. But there are likewise many substances which cannot be dissolved in a fluid, at a settled temperature, in any quantity beyond a certain proportion. Thus water will dissolve only about one-third of its weight of common salt, and, if more be added, it will remain solid. A fluid, which holds in solution as much of any substance as it can dissolve, is said to be saturated with it. But saturation with one substance does not deprive the fluid of its power of acting on and dissolving some other bodies, and in many cases it increases this power. For example, water saturated with salt will dissolve sugar; and water saturated with carbonic acid will dissolve iron, though without this addition its action on this metal is scarcely perceptible.

SATURN. See ASTRONOMY.

SAW, an instrument which serves to cut into pieces several solid matters: as wood, stone ivory, &c. The best saws are of tem-

pered steel ground bright and smooth; those of iron are only hammer-hardened: hence, the first, besides their being stiffer, are likewise found smoother than the last.

SAWING, dividing timber, &c. by the application of a saw, either by the hand or mill. The mechanism of a sawing-mill may be reduced to three principal things: the first, that the saw be drawn up and down as long as is necessary, by a motion communicated by water or steam to the wheel: the second, that the piece of timber to be cut into boards be advanced by an uniform motion to receive the strokes of the saw; for here the wood is to meet the saw, and not the saw to follow the wood, therefore the motion of the wood and that of the saw ought immediately to depend the one on the other: the third, that when the saw has cut through the whole length of the piece, the machine stops of itself, and remains immoveable.

SCALE, a mathematical instrument, consisting of several lines drawn on wood, brass, silver, &c. and variously divided, according to the purposes it is intended to serve; whence it acquires various denominations, as the plain scale, diagonal scale, plotting scale, Gunter's scale, &c.

SCAMMONY, in the materia medica. See CONVOLVULUS, and GUM RESINS.

SCANDALUM MAGNATUM, is the special name of a statute, and also of a wrong done to any high personage of the land, as prelates, dukes, marquises, earls, barons, and other nobles; and also the chancellor, treasurer, clerk of the privy seal, steward of the house, justice of one bench or other, and other great officers of the realm, by false news, or horrible or false messages, whereby debates and discord, betwixt them and the commons, or any scandal to their persons, might arise. This statute has given name to a writ, granted to recover damages thereupon.

SCAPEMENT, a general term for the manner of communicating the impulse of the wheels to the pendulum of a clock. Common scapements consist of the swing wheel and pallets only.

SCAPULA. See ANATOMY.

SCAPULAR. See ANATOMY.

SCARABÆUS, *beetle*, a genus of insects of the order coleoptera. The generic character is, antennæ or horns clavate, with a fissile tip; legs generally toothed; body thick and compact. This genus is extremely extensive, there being nearly one hundred species.

SCARIFICATION, in surgery, the operation of making several incisions in the skin by means of lancets, or other instruments, particularly the cupping instrument.

SCAVENGERS, two officers annually chosen in every parish in London and its suburbs, by the churchwardens, constables, and other inhabitants, to hire persons called rakers, with carts, to clean the streets, and carry away the dirt and filth, with the ashes and dust from every house.

SCENOGRAPHY, in perspective, the perspective representation of a body on a plane; or a description and view of it in all its parts and dimensions, such as it appears to the eye in any oblique view.

SCHISTUS, in mineralogy, a name given to several different kinds of stones, but more especially to some of the argillaceous kind.

SCHOLIUM, a note, annotation, or remark, occasionally made on some passage, or proposition, of an old author. This term is much used in geometry, and other parts of mathematics.

SCIOPTIC, a sphere, or globe of wood, with a circular hole or perforation, wherein a lens is placed. It is so fitted that, like the eye of an animal, it may be turned round every way, to be used in making experiments in a darkened room.

SCIRE FACIAS, is a judicial writ, and properly lies after a year and a day after judgment given; whereby the sheriff is commanded to summon or give notice to the defendant, that he appear and shew cause why the plaintiff should not have execution.

SCIURUS, SQUIRREL, a genus of quadrupeds of the order glires; the generic character is, upper front-teeth cuneated, lower sharp; grinders in the upper jaw five on each side, in the lower four; clavicles in the skeleton; tail (in most species) spreading towards each side. The animals composing this elegant genus are remarkable for the liveliness of their disposition, the celerity of their motions, and the general beauty and neatness of their appearance. They inhabit woods, live entirely on vegetable food, and take up their residence in the hollows of trees, where they prepare their nests.

SCLEROTICA, in anatomy, one of the tunics, or coats, of the eye.

SCOLD. A common scold is a public nuisance to her neighbourhood, for which offence she may be indicted.

SCOLOPAX, in ornithology, a genus belonging to the order of grallæ. The back is cylindrical, obtuse, and longer than the head; the nostrils are linear; the face is covered, and the feet have four toes. There are fifty species, of which the following are the chief:

S. arquata, or the common curlew, is generally about two feet long, and is to be met with in England throughout the year, either on the coasts, or near the mountains. Slugs and worms, which its bill extracts from the ground in the morning and the evening, constitute its inland subsistence; and when on the shores of the sea, it feeds on marine animals. These birds are often observed in large flocks, and are used by many for food. Those killed on the coasts, however, are rank and fishy.

S. rusticola, or the woodcock. These birds are about fourteen inches in length. They are migratory in this country, and supposed to proceed from Sweden.

S. gallinago, or the snipe, weighs about four ounces, is about twelve inches long, and to be found in nearly every country of the world. Its food consists of worms and insects, which it seeks near small streamlets, and in general in wet grounds. It eats also slugs.

S. ægocephalus, or the common godwit, is of the weight of twelve ounces, and ranks in the highest order of delicacies. It is found in almost every country, and in the marshy grounds of Lincolnshire and Cambridgeshire is particularly abundant.

S. calidris, or redshank, is not uncommon in this island, and particularly towards the south.

SCOLOPENDRA, Centipede, a genus of insects of the order aptera; the generic character is, antennæ setaceous; body depressed; legs numerous, equalling the number of segments of the body on each side; feelers two, setaceous. The larger species of the genus scolopendra, found only in the hotter regions of the globe, are insects of a formidable appearance, and possess the power of inflicting severe pain and inflammation by their bite. Of those one of the most conspicuous is the scolopendra morsitans, a native of many parts of Asia, Africa, and South America.

SCOMBER, Mackrel, a genus of fishes of the order thoracici; the generic character is, body oblong, smooth, sometimes carinated by the lateral line; finlets (in most species) above and below, towards the tail. There are 22 species, of which the most remarkable is, the *scomber scomber*, common mackrel. This beautiful fish is a native of the European and American seas, generally appearing at stated seasons, and swarming, in vast shoals, round particular coasts. Its great resort, however, seems to be within the arctic circle, where it resides in innumerable troops; grows to a larger size than elsewhere, and is supposed to find its favourite food, consisting chiefly of marine insects, in far greater plenty than in warmer latitudes. The shape of the mackrel is highly elegant, and it is justly considered as one of the most beautiful of the European species. Its merit as an article of food universally established, and it is one of those fishes which have maintained their reputation through a long succession of ages.

SCORIA, or Dross, is that mass which is produced by melting metals and ores, and when cold is brittle, and not insoluble in water, being properly a kind of glass.

SCORING, the art of forming a score by collecting and properly arranging under each other the several detached parts of any composition.

SCORPÆNA, a genus of fishes of the order thoracici. The generic character is, head large, aculeated, cirrhose, without scales, subcompressed; eye placed near each other; teeth in the jaws, palate, and throat; gill-membrane seven-rayed; body fleshy; dorsal fin single, with the rays of the fore part spiny Nine species.

SCORPIO, in natural history, a genus of insects of the order aptera. Generic character: eight legs, besides two claspers, or hands, seated on the fore-part of the head; eight eyes, three placed on each side of the thorax, and two on the back: two feelers projecting cheliform; the lip is bifid, and the tail long, jointed, and terminated by a sharp, crooked sting; on the under-side, between the breast and abdomen, are two instruments resembling a comb. There are ten species, all of which are armed with a slight pungent sting; and in hot climates some of them are highly dangerous: they prey upon worms, spiders, flies, &c. and even on one another.

SCOTLAND. By 5 Anne, c. 8, the union of England and Scotland was effected, and the twenty-five articles of union agreed to by the parliaments of both nations, were ratified and confirmed as follows; viz. the succession to the monarchy of Great Britain, shall be the same as was before settled with regard to that of England. The united kingdoms shall be represented by one parliament. There shall be a communication of all rights and privileges between the subjects of both kingdoms, except where it is otherwise agreed. When England raises 2,000,000*l.* by land-tax, Scotland shall raise 48,000*l.*; the standards of the coin, of weights and measures, shall be reduced to those of England, throughout the united kingdoms. The laws relating to the trade, customs, and the excise, shall be the same in Scotland as in England; but all the other laws of Scotland shall remain in force, though alterable by the parliament of Great Britain; and particularly laws relating to public policy, are alterable at the discretion of parliament; laws relating to private right are not to be altered, but for the evident utility of the people of Scotland. Sixteen peers are to be chosen to represent the peerage of Scotland in parliament, and forty-five members to sit in the house of commons.

SCRUPLE, a weight equal to the third part of a drachm, or to twenty grains.

SCULPTURE. Sculpture is an art, in which, by means of taking away, or adding to, matter, all sorts of figures are formed, either in clay or wax, wood, marble or other stones, or metal.

The art of sculpture, in its most extensive sense, comprehends not only carving in wood, stone, or marble, but also enchasing, engraving in all its kinds, and casting in bronze, or lead, wax, and plaster of Paris, as well as modelling in clay, wax, or stucco.

The art of sculpture, like its sister, painting, is imitative, not for the gratification of the eye only, but also of the intellect. It is capable of expressing all forms that fall under our inspection, and also of conveying more select expressions of beauty than are to be found, either by ordinary observation, or are generally united in one body, and which are therefore called ideal forms.

Little need be said of the mechanical part of this art, as various chisels, a mallet, compasses, and materials for polishing marble, are all that is required; the essential is seated in the mind, and, as Roubiliac used to say, "the figure is in the substance of the marble, I only extricate it from the enclosure, or pick it out."

SCUTAGE, was anciently a tax imposed on such as held lands, &c. by knight's service, towards furnishing the king's army.

SCUTTLES, in a ship, square holes cut in the deck, big enough to let in the body of a man, serving to let people down into any room below upon occasion, or from one deck to another.

SEA, is frequently used for that vast tract of water encompassing the whole earth; but is more properly a part or division of these waters, and is better defined a lesser assemblage of water, which lies before, and washes the coasts of, some particular countries, from whence it is generally denominated, as the Irish Sea, the Mediterranean Sea, the Arabian Sea, &c.

SEAL, a puncheon or piece of metal, or other matter, usually either round or oval, whereon are engraven the arms, device, &c of some prince, state, community, magistrate, or private person, often with a legend or subscription, the impression whereof in

wax, serves to make acts, instruments, &c. authentic.

SEALER, an officer in chancery, appointed by the lord chancellor or keeper of the great seal, to seal the writs and instruments there made in his presence.

SEAM, or SEME *of corn*, is a measure of eight bushels.

SEAM *of glass*, the quantity of 120 pounds, or 24 stones each five pounds weight. The seam of wood is a horse-load.

SEAMS *of a ship*, are places where her planks meet and join together.

SEARCHER, an officer of the customs, whose business it is to search and examine all ships outward-bound, to see whether they have any prohibited or unaccustomed goods on board.

SEAR *cloth*, or CERE *cloth*, in surgery, a form of external remedy somewhat harder than an unguent, yet softer than an emplaster, though it is frequently used both for the one and the other.

SEA SALT, is merely muriate of soda.

SECALE, *rye*, a genus of the digynia order, in the triandria class of plants; and in the natural method ranking under the 4th order, gramina.

Rye is commonly sown on poor, dry, limestone, or sandy soils, where wheat will not thrive. By continuing to sow it on such a soil for two or three years, it will at length ripen a month earlier than that which has been raised for years on strong cold ground.

SECANT, in geometry, is a line that cuts another, or divides it into two parts.

In trigonometry, the secant denotes a right line drawn from the centre of a circle, which cutting the circumference, proceeds till it meets with a tangent to the same circle.

SECOND, in geometry, chronology, &c. the sixtieth part of a prime or minute; whether of a degree, or of an hour; it is denoted by two small accents, thus (″).

SECONDARY ROCKS. See MINERALOGY.

SECRETARY, an officer who by his master's orders writes letters, dispatches, and other instruments, which he renders authentic by his signet.

SECRETION, in the animal economy, the separation of some fluid mixed with the blood by means of the glands.

SECTION, in geometry, denotes a side or surface appearing of a body or figure cut by another; or the place where lines, planes, &c. cut each other.

SECTION *of a building*, is the same with its profile; or a delineation of its heights and depths raised on a plane, as if the fabric was cut asunder to discover its inside.

SECTOR, in geometry, is a part of a circle, comprehended between two radii and the arch; or it is a mixed triangle, formed by two radii and the arch of a circle.

SECUNDINES, *after birth*, in anatomy, the several coats or membranes wherein the fœtus is wrapped up in the mother's womb, as the chorion and amnios, with the placenta, &c.

SEED, in botany, the essence of the fruit of every vegetable. Linnæus denominates it to be a deciduous part of the plant, containing the rudiments of the new vegetable, and fertilized by the sprinkling of the male dust.

SEDITION, among civilians, is used for a factious commotion of the people, or an assembly of a number of citizens without lawful authority, tending to disturb the peace and order of the society.

SEGMENT *of a sphere*, is a part of a sphere terminated by a portion of its surface, and a plane which cuts it off, passing somewhere out of the centre; being more properly called the section of a sphere.

SEIGNIORY, *dominium* in our law, is used for a manor or lordship of a seigneur, or lord of the fee or manor.

SEIGNORAGE, signifies the right, or due belonging to a seigneur, or lord: but it is particularly used for a duty belonging to the prince, for the coining of money, called also coinage; which under our ancient kings was five shillings for every pound of gold brought in the mass to be coined; and a shilling for every pound weight of silver. At present the king claims no seignorage at all.

SEISIN, in law, signifies possession.

SEIZE, SEAZE, or *sease*, in the sea-language, is to make fast, or bind, particularly to fasten two ropes together with rope-yarn.

SEIZURE, in commerce, an arrest of some merchandize, moveable, or other matter, either in consequence of some law, or of some express order of the sovereign.

SELENIUM, (from σεληνη, the moon,) indicating its analogy to Tellurium, is the name given to a substance discovered by Berzelius, having the properties of a metal combined with those of sulphur to a great degree.

Its colour is grey; its lustre bright metallic. It fuses at a few degrees above the boiling point of water; and when slowly cooled, assumes a granular fracture. It unites with the metals.

SELL, in building, is of two kinds, viz. ground-sell, which denotes the lowest piece of timber, in a timber building, and that on which the whole superstructure is raised; and the window-sell, called also window-soil, is the bottom piece in a window-frame.

SEMEN, a substance prepared by nature for the reproduction and conservation of the species both in animals and plants. The peculiar liquid secreted in the testes of males, and destined for the impregnation of females, is known by the name of semen.

SEMI-*circle*, in geometry, half a circle, or that figure comprehended between the diameter of a circle and half the circumference.

SEMI-*colon*, in grammar, one of the points or stops used to distinguish the several members of sentences from each other (;).

SEMI-*diurnal*. Of any of those circles which the sun appears to perform each daily revolution, that portion which is above the horizon is called the diurnal arch, and that which is below the horizon is called the nocturnal arch, the halves of which are called the semi-diurnal and the semi-nocturnal arches.

SENECIO, *groundsel*, a genus belonging to the class of syngenesia, and to the order of polygamia superflua, and in the natural classification ranked under the 49th order, compositæ There are 75 species. Of these, seven are British; the vulgaris, viscosus, sylvaticus, crucifolius, jacobæa, paludosus, and saracenicus.

SENSITIVE PLANT. See MIMOSA.

SENTENCE, in grammar, a period or set

of words comprehending some perfect sense or sentiment of the mind.

SEPIA, the *cuttle-fish*, a genus belonging to the order of vermes mollusca. There are eight brachia interspersed on the interior side, with little round serrated cups, by the contraction of which the animal lays fast hold of any thing. Besides these eight arms, it has two tentacula longer than the arms, and frequently pedunculated. The mouth is situated in the centre of the arms, and is horny and hooked. The eyes are below the tentacula, towards the body of the animal. The body is fleshy, and received into a sheath as far as the breast. Their food are tunnies, sprats, lobsters and other shell-fish. With their arms and trunks they fasten themselves, to resist the motion of the waves. Their beak is like that of a parrot. The females are distinguished by two paps.

The bony scale on the back is that which is sold in the shops, and which, when reduced to fine powder, is reckoned excellent for the teeth, as well for keeping them white as for preserving them. It is also used as pounce. These animals have the power of squirting out a black fluid resembling ink, which is said to be an ingredient used in the composition of Indian ink. They deposit their eggs upon sea-weed, which resemble a bunch of grapes. When first deposited they are white, but when impregnated by the male they become black; they are round, with a little point at the end, and in each of them is inclosed a living cuttle-fish, surrounded with a gelatinous fluid. The flesh is used as food by the Italians.

SEPTUAGINT, the name given to a Greek version of the books of the Old Testament, from its being supposed to be performed by seventy-two Jews, who are usually called the seventy interpreters, because seventy is a round number.

SEPTUM. See ANATOMY.

SEQUESTRATION, is the separating or setting aside of a thing in controversy from the possession of both those who contend for it.

A sequestration is also a kind of execution for debt, especially in the case of a beneficed clerk, of the profits of the benefices, to be paid over to him that had the judgment, till the debt is satisfied.

SERGE, in commerce, a woollen stuff manufactured in a loom, of which there are various kinds, denominated either from their different qualities, or from the places where they are wrought; the most considerable of which is the English serge, which is highly valued abroad, and of which a manufacture had been for some years carried on in France.

SERGEANT, or **SERJEANT AT LAW**, is the highest degree taken in that profession, as that of a doctor is in the civil law. To these serjeants, as men of great learning and experience, one court is set apart for them to plead in by themselves, which is the court of common pleas, where the common law of England is most strictly observed; yet though they have this court to themselves, they are not restrained from pleading in other courts, where the judges (who cannot be elevated to that dignity till they have taken the degree of serjeant at law) call them brothers, and hear them with great respect, next to the king's attorney and solicitor general. These are made by the king's mandate, or writ.

SERGEANT, or *Serjeant*, in war, is an inferior officer in a company of foot, or troop of dragoons, armed with a halberd, and appointed to see discipline observed, to teach the soldiers the exercise of their arms, and to order, straighten, and form, ranks, files, &c

SERIES, in general, denotes a continued succession of things in the same order, and having the same relation or connection with each other.

SERIES, *infinite*, is a series consisting of an infinite number of terms, that is, to the end of which it is impossible to come; so that let the series be carried on to any assignable length, or number of terms, it can be carried yet farther, without end or limitation.

SERPENTES, in natural history, an order of the amphibia class, the characteristics of which are, a mouth breathing by the lungs only; body tapering; neck not distinct; jaws dilatable, not articulate; no feet, fins, or ears: motion undulatory. They are cast naked upon the earth, without limbs, exposed to every injury, but frequently armed with a poison the most deadly and horrible, which is contained in tubular fangs resembling teeth, placed without the upper jaw, protruded or retracted at pleasure, and surrounded with a glandular vesicle, by which this fatal fluid is secreted. But lest this tribe should too much encroach upon the limits of other animals, the benevolent Author of Nature has armed only about a fifth in this dreadful manner. The jaws are dilatable and not articulate, and the œsophagus so lax, that they can swallow without mastication, an animal twice or thrice as large as the neck. There are seven genera, viz. the

Achrochordus
Amphisbæna
Anguis
Boa.
Coecilia
Coluber
Crotalus

The distinction between the poisonous and innoxious serpents, is only to be known by an accurate examination of their teeth; those which are poisonous being always tubular, and calculated for the injection of the poisonous fluid, from a peculiar reservoir communicating with the fang on each side the head. These teeth or fangs are situated in the upper jaw: they are frequently accompanied by smaller fangs, seemingly intended to supply the place of the others, if lost by age or accident. The fangs are situated in a peculiar bone, so articulated with the rest of the jaw as to elevate or depress them at the pleasure of the animal in a quiescent state they are recumbent, with their points directed inwards or backwards; but when the animal is inclined to use them as weapons of offence, their position is altered by the peculiar mechanism of the bone in which they are rooted, and they become almost perpendicular.

Serpents in cold and temperate climates conceal themselves during winter, in cavities beneath the surface of the ground, or in any other convenient places of retirement, where they become nearly or wholly in a state of torpidity. Some serpents are viviparous, as the rattle-snake; the viper, &c.: while the innoxious species are oviparous, depositing, as we have observed, their eggs in a kind of chain in any warm and close situation, where they are afterwards hatched

The broad undivided laminæ on the bellies of serpents, are termed scuta, and the smaller or divided ones beneath the tail are called

subcaudal scales, and from these different kinds of laminæ, the Linnæan genera are characterized.

SERPENTINE, a mineral found in amorphous masses, forming strata, and even entire mountains. Its fracture is splintery, sometimes conchoidal; feels soft and almost greasy; generally emits an earthy smell when breathed on. Its colours are various shades of green, yellow, red, grey, brown, and blue: commonly one or two colours form the ground, and one or more appear in spots or veins.

This stone takes its name from its variegated colours, which, in their disposal, very much resemble a serpent's skin.

SERVANT. See Master and Servant.

SERVICE, in law, is a duty which a tenant, on account of his fee, formerly owed to his lord.

SERUM, a thin transparent liquor which makes a considerable part in the mass of blood.

SESSION, in law, denotes a sitting of justices in court upon their commission: as the session of oyer and terminer, &c.

Sessions, *quarter*. The session of the peace is a court of record holden before two or more justices, whereof one is of the quorum, for the execution of the authority given them by the commission of the peace, and certain statutes and acts of parliament.

The justices shall keep their sessions in every quarter of the year at least, and for three days if need be; to wit, in the first week after the feast of St. Michael, in the first week after the Epiphany, in the first week after Easter, and in the first week after St. Thomas, and oftener if need be.

Any two justices, one whereof is of the quorum, by the words of the commission of the peace, may issue their precepts to the sheriff to summon a session for the general execution of their authority; and such session, holden at any time within that quarter of a year, is a general quarter-session. 4. Burn, 181. And such precept should bear teste, or be dated, fifteen days before the return. Nels. Intr. 35.

The sheriff also shall cause a jury to appear at such days and places as the said justices, or such two or more of them as aforsaid, shall appoint.

SET-*off*, is when the defendant acknowledges the justice of the plaintiff's demand on the on hand, but on the other sets up a demand of his own to counterbalance that of the plaintiff, either in the whole, or in part: as if the plaintiff sues for 10*l.* due on a note of hand, the defendant may set off 9*l.* due to himself for merchandize sold to the plaintiff.

SET, or **Sets**, a term used by the farmers and gardeners to express the young plants of the white thorn and other shrubs, with which they use to raise their quick or quickset hedges.

SETON, in surgery, a few horse hairs, small threads, or large packthread drawn through the skin, chiefly the neck, by means of a large needle or probe, with a view to restore or preserve health.

SETTING, in astronomy, the withdrawing of a star or planet, or its sinking below the horizon. Astronomers and poets make three different kinds of setting of the stars, *viz.* the cosmical, achromial, and helical.

Setting, in the sea language. To set the land or the sun, by the compass, is to observe how the land bears on any point of the compass, or on what point of the compass the sun is.

SEWER, a passage or gutter made to carry water into the sea or a river, whereby to preserve the land &c. from inundations and other annoyances. The business of the commissioners of sewers, or their office in particular, is to repair sea-banks and walls, survey rivers, public streams, ditches, &c. and to make orders for that purpose.

SEXAGESIMALS, or **Sexagesimal fractions**, fractions whose denominators proceed in a sexagecuple ratio: that is, a prime or the first minute, $= \frac{1}{60}$; a second $= \frac{1}{3600}$; a third $= \frac{1}{21600}$.

Anciently there were no other than sexagesimas used in astronomy, and they are still retained in many cases, though decimal arithmetic is now generally used in astronomical calculations.

SEXTANT, in mathematics, denotes the sixth part of a circle, or an arch comprehending sixty degrees.

The word sextant is more particularly used for an astronomical instrument made like a quadrant, excepting that its limb only comprehends sixty degrees. The use and application of the sextant is the same with that of the quadrant. See Quadrant.

SEXTON, a church-officer, whose business is to take care of the vessels, vestments, &c. belonging to the church, and to attend the minister, churchwardens, &c. at church.

SEXUAL *system*, in botany, that system of classification which was invented by the immortal Linnæus, professor of physic and botany, at Upsal, in Sweden. It is founded on the parts of fructification, viz. the stamens and pistils; these having been observed with more accuracy since the discovery of the uses for which nature has assigned them, a new set of principles have been derived from them, by means of which the distribution of plants has been brought to a greater decision, and rendered more conformable to true philosophy, in this system, than in any one of those which preceded it.

SHADOW, in optics, a privation or diminution of light, by the interposition of an opake body, or it is a plane where the light is either altogether obstructed, or greatly weakened, by the interposition of some opake body between it and the luminary.

SHAGREEN, or **Chagreen**, in commerce, a kind of grained leather, prepared, as is supposed, of the skin of a species of squalus, or hound-fish, called the shagreen, or shagrain, and much used in covering cases, books, &c.

SHAMMY, or **Chamois Leather**, a kind of leather dressed either in oil or tanned, and much esteemed for its softness, pliancy, and being capable of bearing soap without hurt.

The real shammy is prepared of the skin of the chamois-goat.

The true chamois leather is counterfeited with common goat, kid, and even sheep-skin; the practice of which makes a particular profession, called by the French chamoisure.

SHARK. See Squalus.

SHASTER, or **Shastram**, a sacred book

containing the religion of the Banians; it consists of three tracts; the first of which contains their moral law; the second, the ceremonial; and the third, delivers the peculiar observances for each tribe of Indians.

SHEATHING, in ship-building, a sort of casing or covering nailed all over the outside of a ship's bottom, to protect the planks from the pernicious effects of the worms. It has been customary many years past to sheath the ships of the royal navy, and those of the East India service, with copper. But even vessels thus protected, have been found to return home, after a long voyage, with the copper sheathing extremely injured from the action of the salt water. This led the indefatigable Sir H. Davy, to turn his attention to the subject, and his experiments have been followed with the most complete success. His discovery consists in the simple process of placing contact with the copper, some strips of *positive* metal, zinc for instance, by which the corrosion and foulness from the action of the sea water are prevented.

SHEEP. See Ovis.

SHEERING, or Shearing, in woollen manufacture, is the cutting off with large sheers the too long nap, in order to make the cloth more smooth and even.

SHEKEL, in Jewish antiquity, an ancient coin, worth about 2*s*. 3¼*d*. sterling.

SHELF, among miners, the same with what they otherwise call fast ground, or fast country; being that part of the internal structure of the earth which they find lying even, and in an orderly manner.

SHELL, a substance of a stony hardness, composed of carbonate of lime variously combined with animal gluten, and serving for the coverings and habitations of different animals, mostly of the order of mollusca; allowing of the occasional protrusion of part of their naked body.

Marine shells may be divided, as Mr. Hatchett observes, into two kinds: those that have a porcellaneous aspect, with an enamelled surface, and when broken are often in a slight degree of a fibrous texture; and those that have generally, if not always, a strong epidermis, under which is the shell, principally or entirely composed of the substance called nacre, or mother-of-pearl.

The porcellaneous shells appear to consist of carbonate of lime, cemented by a very small portion of animal gluten. This animal gluten is more abundant in some, however, as in the patellæ.

The mother-of-pearl shells are composed of the same substances. They differ, however, in their structure, which is lamellar, the gluten forming their membranes, regularly alternating with strata of carbonate of lime. In these two the gluten is much more abundant.

Mr. Hatchett made a few experiments on land shells also, which did not exhibit any differences. But the shells of the crustaceous animals he found to contain more or less phosphate of lime, though not equal in quantity to the carbonate, and hence approaching to the nature of bone.

SHERIFF, As keeper of the king's peace, the sheriff is the first man in the county, and superior in rank to any nobleman therein, during his office. He may apprehend and commit to prison all persons who break the peace, or attempt to break it, and may bind any one in a recognizance to keep the king's peace.

SHIELD, an ancient weapon of defence, in the form of a light buckler, borne on the arm to turn off lances, darts, &c.

Shield, in heraldry, the escutcheon or field on which the bearings of coats of arms are placed.

SHIP, a general name for all large vessels, particularly those equipped with three masts and a bowsprit; the masts being composed of a lower-mast, top-mast, and top-gallant-mast; each of these being provided with yards, sails, &c. Ships, in general, are either employed for war or merchandize.

Ships *of war* are vessels properly equipped with artillery, ammunition, and all the necessary martial weapons and instruments for attack or defence. They are distinguished from each other by their several ranks or classes, called rates, as follows: ships of the first rate mount from 100 guns to 110 guns and upwards; second rate, from 90 to 98 guns; third rate, from 64 to 74 guns; fourth rate, from 50 to 60 guns; fifth rate, from 32 to 44 guns; and sixth rate, from 20 to 28 guns. Vessels carrying less than 20 guns, are denominated sloops, cutters, fire-ships, and bombs.

SHIP-BUILDING may be defined, the manner of constructing ships, or the work itself, as distinguished from naval architecture, which may be considered as the theory or art of delineating ships on a plane.

SHIVERS, or Sheevers, in the sea-language, names given to the little rollers or round wheels of pulleys. See Pulley.

SHOE, a covering for the foot, usually made of leather, by the company of cordwainers.

SHORL, in mineralogy, occurs commonly in granite, gneiss, and other similar rocks; often in mass, but very frequently chrystallized.

Shorl, *black*. Colour black. Found in mass, disseminated and crystallized. Crystals three-sided prisms, having their lateral edges truncated. Sometimes terminating in a pyramid. It becomes electric by heat.

SHORT-HAND. See Stenography.

SHOT, a denomination given to all sorts of balls for fire-arms; those for cannon being of iron, and those for guns, pistols, &c. of lead.

SHROWDS, or Shrouds, in a ship, are the great ropes which come down both sides of the masts, and are fastened below to the chains on the ship's side, and aloft to the top of the mast; being parcelled, and served, in order to prevent the mast's galling them.

SIDE, the half of any thing, as an animal, a ship, &c. The sides of an animal are distinguished into the right and left side; but those of a ship, into the starboard and larboard side.

SIDEREAL *day*, is the time in which any star appears to revolve from the meridian to the meridian again; which is 23 hours 56′ 4″ 6‴ of mean solar time; there being 366 sidereal days in a year, or in the time of 365 diurnal revolutions of the sun; that is, exactly, if the equinoctial points were at rest in the heavens.

SIEGE, in the art of war, the encampment of an army before a fortified place, with a design to take it.

SIENITE, or Syenite, a compound gra-

nular aggregated rock, composed of felspar and hornblende, and sometimes quartz and black mica The hornblende is the characteristic ingredient, and distinguishes it perfectly from granite, with which it is often confounded; but the felspar, which is almost always red, and seldom inclines to green, forms the most abundant and essential ingredient of the rock. Some varieties contain a very considerable portion of quartz and mica, but little hornblende. This is particularly the case with the Egyptian varieties, and hence these are often confounded with real granite.

SIEVE, or **Searce**, an instrument serving to separate the fine from the coarse parts of powders, liquors, and the like; or to cleanse pulse from dust, light grains, &c. It is made of a rim of wood, the circle or space whereof is filled with a plexus of silk, tiffany, hair, linen, wire, or even thin slices of wood.

SIGHTS *of a quadrant*, &c. thin pieces of brass, raised perpendicularly on its side, or on the index of a theodolite, circumferentor, &c.

SIGN, in astronomy, a constellation containing a twelfth part of the zodiac, or 30 degrees.

SIGN-MANUAL, in law, is used to signify a bill, or writing, signed by the king's own hand-writing.

SIGNALS, certain alarms or notices used to communicate intelligence to a distant observer.

SIGNATURE, in printing, is a letter put at the bottom of the first page at least, in each sheet, as a direction to the binder, in folding, gathering, and collating them.

SIGNET, one of the king's seals, made use of in sealing his private letters, and all grants that pass by bills signed under his majesty's hand.

SILICA. One of the primitive earths, which in consequence of Sir H. Davy's researches on the metallic bases of the alkalis and earths, has been recently regarded as a compound of a peculiar combustible principle with oxygen. If we ignite powdered quartz with three parts of pure potash in a silver crucible, dissolve the fused compound in water, add to the solution a quantity of acid, equivalent to saturate the alkali, and evaporate to dryness, we shall obtain a fine gritty powder, which being well washed with hot water, and ignited, will leave pure silica.

Silica forms one of the constituent parts of most stony bodies; but it exists in greatest abundance in agates, jasper, flints, quartz, and rock crystal: in the latter it exists nearly in a state of purity. Silica is frequently found in nature in the crystallized form, and then it is distinguished by the name of rock crystal. It is most commonly in hexagonal prisms, terminated by hexagonal pyramids.

SILK, in natural history, is the production of different species of caterpillars. The phalæna, or bombyx mori, is most commonly propagated for that purpose in Europe; but the phalena atlas yields a greater quantity. See Bombyx, and Phalæna. A similar substance, indeed, is yielded by the greater number of the tribe of caterpillars. It is found inclosed in two small bags, from which it is protruded in fine threads to serve the insect for a covering during its chrysalis state. The webs of spiders are obviously of the same nature with silk, though their fibres, at least in this country, are finer and weaker.

As soon as the worms have produced their balls, or cocoons, they become an article of trade, for in those countries where silk is cultivated, few persons reel off their cocoons, but sell them to others, who make this operation a separate business. The silk, as formed by the worm, is so very fine, that if each ball, or cocoon, was reeled separately, it would be totally unfit for the purposes of the manufacturer; in the reeling, therefore, the ends of several cocoons are joined and reeled together out of warm water, which, softening their natural gum, makes them stick together, so as to form one strong smooth thread.

The culture of silk varies but little in different countries; it does not require any great degree of skill, or a great capital: and as it is well known that the silk-worm, with proper care, will breed and thrive very well in England, it is not surprising that attempts should have been made to establish the culture of it in this country. The success of Henry the Fourth of France, in extending the culture of silk, which before his time had been confined to a few districts of that kingdom, excited in James the First an active zeal for the introduction of it here. The insurmountable obstacle to raising silk in Great Britain is the climate, which is too cold and wet; and though expedients might be adopted to obviate these inconveniences, they would render the culture of the article, on a large scale, by far too expensive.

In the British settlements in the East Indies, the culture of silk has been long established, particularly in the island of Cossimbwzar and its neighbourhood, in the province of Bengul; and since, about the year 1760, when the company became the rulers of the country, and adopted a new system of trade for the purpose of realizing the surplus revenue, the culture of raw silk has been promoted, and the quantity considerably increased. Of late years, considerable attention has been paid both to the quality of the silk, and to the mode of reeling it, by which it has been very materially improved, so as to rival, in most respects, the produce of Italy.

At no period, perhaps, was the silk trade of Britain known to be in so flourishing a state as it is at present. To a superficial observer, this may appear to arise from the recent reduction of the duty on the raw material; and doubtless this has contributed its share; but we are well satisfied that much also is owing to the very superior quality, and the great beauty of the various articles of home manufacture. As a specimen, we need only refer to the fancy article of an elastic nature, manufactured by Messrs. W. and T. Haimes, of Melbourn, Derbyshire. This article, which we believe was originally meant to imitate a similar article made in France, is used chiefly among the higher orders of society in the form of shawls, turbans, ball-dresses, &c. is now produced by them in a style far exceeding the original. Of this truly ingenious process, some account will be given, under the proper head, in the London Encyclopædia.

SILVER. See Chemistry.

SILVERING, in the arts, consists in covering the surfaces of substances with a thin

coating of silver; either for the purpose of beauty, silver being so much more handsome than the inferior metals; or, on account of its superior wholesomeness, compared with copper, brass, or lead, for culinary purposes, it resisting the corroding power of vinegar and other weak acids.

SILURUS, a genus of fishes of the order abdominales. The generic character is, head large, depressed; mouth wide, bearded by long tentacula; body lengthened, naked; first ray of the pectoral fins, or of the first dorsal fin, toothed backwards. There are 28 species.

SIMIA, ape, a genus of quadrupeds of the order primates. The Linnæan generic character is, front teeth in each jaw four, placed near together; canine teeth solitary, longer than the others, distant from the remaining teeth, or grinders; grinders obtuse. This numerous race may be properly divided into four sections, of which there are about 70 species, viz. 1. Apes, or such as are destitute of a tail. 2. Baboons, or such as have very muscular bodies, and whose tails are commonly short. 4. Monkeys, whose tails are, in general, long: and, lastly sapajous, or monkeys, with what are termed prehensile tails, viz. such as can, at pleasure, be twisted round any object, so as to answer the purpose of an additional hand to the animal,

Of the whole genus, or the monkey tribe in general, it may be observed, that the baboons are commonly of a ferocious and sullen disposition. The larger apes are also of a malignant temper, except the ourang-ontang and the gibbons. The monkeys, properly so called, are very various in their dispositions; some of the smaller species are lively, harmless, and entertaining; while others are as remarkable for the mischievous malignity of their temper, and the capricious uncertainty of their manners.

It may not be improper here to observe, that it is not easy to determine with precision the several species of this extensive genus; since, exclusive of the varieties in point of colour, they are often so nearly allied as to make it difficult to give real distinctive characters.

SIMILAR, in arithmetic and geometry, the same with like. In mathematics, similar parts have the same ratio to their wholes; and if the wholes have the same ratio to the parts, the parts are similar. Similar angles are also equal angles.

SIMILE, or SIMILITUDE, in rhetoric, a comparison of two things, which, though different in other respects, yet agree in some one.

SIMILITUDE, in arithmetic, geometry, &c. denotes the relation of two things similar to each other.

SIMONY, is the corrupt presentation of any one to an ecclesiastical benefice, for money, gift, reward, or benefit.

SIMOOM. A wind or haze was observed by Mr. Bruce, in the course of his travels to discover the sources of the Nile, which is supposed to be in some respects analogous to the sirocco. It is called by him the simoom, and from its effects upon the lungs, we can entertain but little doubt, that it consists chiefly of carbonic acid gas in a very dense state, and perhaps mixed with some other noxious exhalations.

SIMPLE, something not mixed or compounded, in which sense it stands opposed to compound.

SIMPLE, in pharmacy, a general name given to all herbs or plants, as having each its particular virtue, whereby it becomes a simple remedy.

SINAPIS, *mustard*, a genus of plants belonging to the class of tetradynamia, and to the order of siliquosa, and in the natural system ranged under the 39th order, siliquosæ. There are 19 species, three of them natives of Britain.

SINE, or *right* SINE *of an arch*, in trigonometry, is a right line drawn from one end of that arch, perpendicular to the radius drawn to the other end of the arch; being always equal to half the chord of twice the arch.

SINE-*cure*, is where a rector of a parish has a vicar under him endowed and charged with the cure, so that the rector is not obliged either to do duty or residence.

SINKING FUND, a portion of the public revenue set apart to be applied to the reduction or discharge of the public debts. The appropriation of a part of the revenue to this purpose is a measure which had been adopted in other countries, long before any necessity for it existed in England; a provision of this kind having been established in Holland in 1655, and in the Ecclesiastical State in 1685. Both these funds originated in a reduction of the interest payable on the public debts, which was the means afterwards adopted for the establishment of a similar fund in this country.

SIPHON, or SYPHON. See HYDRAULICS.

SIPUNCULUS, or *tube-worm*, a genus of insects of the order of vermes intestina: the generic character is, body round, elongated; mouth cylindrical at the end, and narrower than the body; aperture at the side of the body, and verruciform. There are two species.

SIREN, a genus of amphibia, of the order meantes, of which there are the following species:

1. *Siren lacertina*, or eel-shaped siren: This species stands eminently distinguished in the list of animals by the ambiguity of its characters, which are such as to have induced the great Linnæus to institute for it a new order of amphibia, under the title of meantes; an order however which does not stand among the rest of the amphibia in the Systema Naturæ, but is mentioned in a note at the end of the second part of the first volume of that work.

2. *Siren anguina*, [illegible]ine siren. This singular animal is found in as singular a situation, being an inhabitant of the celebrated and romantic lake called Lake Zirknitz, about six German miles from Labac, in the duchy of Carolina, in Austria.

The species of siren at present to be described is extremely rare; and is found in the spring, and towards the decline of summer, in some particular parts of the above mentioned lake; and commonly measures, when full-grown, from about ten to twelve or thirteen inches in length; the largest specimens being near three quarters of an inch in diameter. It is entirely of a pale rose or flesh-colour, or even nearly white, except the three pair of ramified branchial fins on each side the neck, which are of a bright red or carmine-colour. Its general shape is that of an eel.

SIRIUS, the *dog-star*; a very bright star of the first magnitude, in the mouth of the constellation Canis Major, or the Great Dog. This is the brightest of all the stars in our fir-

mament, and therefore probably, says Dr. Maskelyne, the astronomer royal, the nearest to us of them all.

SIROCCO, a periodical wind which generally blows in Italy and Dalmatia, every year, about Easter. It blows from the south-east by south; it is attended with heat, but not rain; its ordinary period is twenty days, and it usually ceases at sun-set.

SITTA, *nut-hatch*, a genus belonging to the class of aves, and order of picæ. The bill is for the most part straight; on the lower mandible there is a small angle; nostrils small, covered with bristles reflected over them; tongue short, horny at the end, and jagged; toes placed three forward and one backward, the middle toe joined closely at the base to both the outmost: back toe as large as the middle one. There are eleven species.

SIUM, *water parsnip*, a genus of plants belonging to the class of pentandria, and order of digynia, and in the natural system ranging under the 45th order, umbellatæ.

SIZE, is a sort of glue, used by painters, &c. The shreds and parings of leather, parchment, or vellum, being boiled in water and strained, make size. This substance is used in many trades.

SKELETON, in anatomy, an assemblage or arrangement of all the bones of a dead animal, dried, cleansed, and disposed in their natural situation, and kept in that order by means of wires, &c.

SKIN. See CUTIS.

SKINNER, one who works in skins.

SKULL, in anatomy, that part of the head which forms its great bony cavity; and in a living subject contains the brain. See ANATOMY.

SKY, the blue expanse of air and atmosphere. The azure colour of the sky Sir Isaac Newton attributes to vapours beginning to condense there, and which have got consistence enough to reflect the most reflexible rays.

SLAB, an outside sappy plank or board sawed off from the sides of a timber-tree; the word is also used for a flat piece of marble.

SLAG, is a term used by the persons employed in working minerals, to express any [illegible] vitrescent, generally coloured, opaque mass, produced by the fusion of any stony or metallic mixture.

SLATE, a well kno[illegible] neat, convenient, and durable material, for the covering of the roofs of buildings. There are great varieties of this substance, and it likewise differs very greatly in its qualities and colours. In some places it is found in thick lamina or flakes, while in others it is thin and light. The colours are white, brown, and blue. It is so durable in some cases, as to have been known to continue sound and good for centuries.

SLAVERY. The law of England abhors, and will not endure, the existence of slavery within this nation. A slave or negro, the moment he lands in England, falls under the protection of the laws, and becomes a free man.

SLEDGE, a kind of carriage without wheels, for the conveyance of very weighty things, as huge stones, &c.

SLEEPERS, in a ship, timbers lying before and aft, in the bottom of the ship, as the rung-heads do; the lowermost of them is bolted to the rung-heads, and the uppermost to the fut-

SLING, an instrument serving for casting stones with great violence. The inhabitants of the Balearic islands were famous in antiquity, for the dexterous management of the sling; it is said they bore three kinds of slings, some longer, others shorter, which they used according as their enemies were either nearer or more remote. It is added, that the first served them for a head band, the second for a girdle, and that a third they constantly carried with them in the hand.

SLOE, prunis sylvestris, the English name for the wild plum. See PRUNUS.

SLOOP, a sort of small ship or vessel, usually with one mast, otherwise called shallop. In our navy, sloops are tenders on the men of war, and are usually of about sixty tons, and carry about thirty men.

SLUICE, in hydraulics, a frame of timber, stone, earth, &c. serving to retain and raise the water of the sea, a river, &c. and to let it pass off as occasion may require.

SMELL, *sense of*. The sense of smell is very nearly allied to that of taste, and indeed many of those pleasurable sensations which are usually referred to the taste, as being received during the act of eating and swallowing, really belong to the smell. The organ of smell is a membrane or skin, overspread with nerves, which line the internal cavity of the nostrils, and the surface and cavities of the bones which join the nostrils. This is affected both by the odorous particles which proceed from external substances through the nose, and by those which come from the substances which are eaten; for there is a communication between the nose and the back part of the mouth.

SMELTING, in metallurgy, the fusion or melting of the ores of metals, in order to separate the metalline part from the earthy, stony, and other parts. The art of fusing the ores after roasting, is the principal and most important of metallurgic operations, all the other being preliminary or preparative to this.

SMITHERY, or SMITHING, a manual art, by which an irregular lump of iron is wrought into an intended shape.

SMUT, a disease in corn, which destroys entirely the germ and substance of the grain.

SNAIL. See HELIX, and LIMAX.

SNIPE. See SCOLOPAX.

SOAL-*fish*. See PLEURONECTES.

SNOW. See METEOROLOGY.

SNOWDROP. See GALANTHUS.

SNUFF, a powder chiefly made of tobacco, the use of which is too well known to need any description here.

SNAPDRAGON, in botany. See ANTIRRHINUM.

SOAP, a composition of caustic fixed alkaline salt and oil, or other grease. It is sometimes hard and dry, sometimes soft and liquid; much used in washing, and other purposes, as well in the arts and manufactures as in domestic purposes.

The materials used in soap-making are, oil of any kind, vegetable or animal; and fixed alkali, either soda or potash. These, (that is, oil and alkali) enter into the composition of every soap, and, besides, lime is essential to give the alkali the requisite degree of causticity common salt is also employed in most of the potash soaps.

The general process for soap-making is on

the whole very simple; and consists, first, in making a caustic, or partly caustic, ley, with the alkali and lime; next, of boiling the ley with the oil till they are perfectly united into a smooth uniform soap; and lastly, of drying the soap till it is become of a proper consistence for use.

SOCAGE, a tenure of lands by or for certain inferior services of husbandry to be performed to the lord of the fee.

SOCIETIES. This word includes a vast circle of associations of men, calculated in some instances to promote the cause of science and literature, and in others intended for the benefit of the individuals and their families who compose them.

Of the former class are the Royal and Antiquarian Societies, and the more recent establishments, under the term of INSTITUTIONS.

SOCINIANS, in church history, a sect of Christians, so called from their founder Faustus Socinus, a native of Sienna, in Italy. He, about the year 1674, began openly to declare against the Roman catholic faith, and taught, 1. That the eternal father was the one only God; that the Word was no more than an expression of the godhead, and had not existed from all eternity; and that Jesus Christ was God no otherwise than by his superiority above all creatures, who were put in subjection to him by the Father. 2. That Jesus Christ was not a mediator between God and men, but sent into the world to serve as a pattern of their conduct; and that he ascended up to heaven only to take a journey thither. 3. That the punishment of hell will last but for a certain time, after which the body and soul will be destroyed. And 4. That it is not lawful for princes to make war.

SODA, a mineral alkali, sometimes found in a native state, as in the lakes of Natron in Egypt, which are dry in the summer season; the water leaving, after evaporation, a bed of soda, or as it is there called, *natron*, of two feet in thickness. A marine plant, called the *salsola soda*, which grows among the cliffs, on the sea coast, seems to be endowed by nature with the property of decomposing the salt water, that is, of separating the muriatic acid from the soda, which latter it absorbs. This plant is collected by the Spaniards, and burnt for the manufacture of *barilla*. Soda procured in a still more impure state by burning the sea weeds on our own shores, particularly in Scotland, from which *kelp* is produced. Few articles are of greater importance to the arts, manufactures, and domestic economy, than soda; it is indispensably necessary for making hard soap, and also forms an excellent substitute for this article. If a weak solution of soda be poured into foul bottles or casks, in which wine has been kept for some time, it will completely dissolve the tartarous crust formed on their inner surface. Boot tops, saddles, or bridles, may with this liquid be effectually cleansed, without affecting the original colour of the leather.

SOLDERS, and SOLDERING. Solders consist merely of simple or mixed metals, by which alone metallic bodies can be firmly united with each other. In this respect it is a general rule, that the solder should always be easier of fusion than the metal intended to be soldered by it; next to this, care must also be taken, that the solder be as far as is possible of the same colour with the metal that is to be soldered.

For the simple solders, each of the metals may be used, according to the nature of that which is to be soldered. For fine steel, copper, and brass work, gold and silver may be employed. In the large way, however, iron is soldered with copper, and copper and brass with tin.

In the operation of soldering, the surfaces of the metal intended to be joined must be made very clean, and applied to each other. It is usual to secure them by a ligature of iron wire, or other similar contrivance. The solder is laid upon the joint, together with sal ammoniac or borax, or common glass, according to the degree of heat intended. These additions defend the metal from oxidation. Glaziers use resin; and pitch is sometimes employed.

The solder used by plumbers is made of two pounds of lead to one of block-tin. Its goodness is tried by melting it, and pouring the size of a crown piece on a table; for, if good, there will arise little bright shining stars in it.

SOLECISM, *soloecismus*, in grammar, a false manner of speaking contrary to the use of language and the rules of grammar, either in respect of declension, conjugation, or syntax.

SOLEN, *razor sheath, or knife-handle shell*, a genus belonging to the class of vermes, and order of testacea. The animal is an ascidia. The shell is bivalve, oblong, and opening at both sides; the hinge has a tooth shaped like an awl, bent back, often double, not inserted into the opposite shell; the rim at the sides somewhat worn away, and has a horny cartilaginous hinge. There are 23 species; three of them, viz. the siliqua, vagina, and ensis, are found on the British coasts, and lurk in the sand near the low water mark in a perpendicular direction.

SOLID. Geometricians define a solid to be the third species of magnitude, or that which has three dimensions, viz. length, breadth, and thickness or depth.

SOLIDITY is that property of matter, by which it excludes all other bodies from the place which itself possesses.

SOLO, in music, a term used in pieces consisting of several parts, to mark those that are to perform alon

SOLSTICE. See ASTRONOMY.

SOLUTION, in chemistry, denotes an intimate mixture, or perfect union, of solid bodies with fluids, so as seemingly to form one homogenous liquor.

SONG, in poetry, a little composition, consisting of easy and natural verses, set to a tune in order to be sung.

SONG, in music, is applied in general to a single piece of music, whether contrived for the voice or an instrument.

SONG *of birds*. The song of birds has been defined to be a succession of three or four different notes, which are continued without interruption through the same intervals, in a bar of four crotchets, adagio, or while a pendulum swings four seconds.

SOOT, a volatile matter, arising from wood, and other fuel, along with the smoke; or rather, it is the smoke itself, fixed and gathered on the sides of the chimney.

SOPHISM, in logic, &c. an argument which carries much of the appearance of truth, and yet leads into error.

SOREX, *shrew*, a genus of quadrupeds, of the order feræ. The generic character is, front teeth in the upper jaw two, long, bifid; in the lower, two or four, the intermediate ones shorter; canine teeth several on each side; grinders cuspidated.

The genus sorex, of which there are 17 species, in its general appearance bears a great resemblance to the mouse tribe; but the structure, number, and situation of the teeth, prove it to constitute a very different set of animals, which are evidently rather carnivorous than frugivorous.

SOUND is produced by a vibrating motion, excited in a sonorous body by a blow or a shock from another body; and the same motion is communicated by this sonorous body to the air which surrounds it, and transmitted by this fluid to the ear, which is an organ admirably adapted to receive its impression.

The external ear collects and modifies sounds; and by a long channel communicates them to the internal ear: this consists, in the first place, of what is called the drum of the ear, which is a small cavity, closed towards the opening of the ear by a delicate membrane. In the drum are three or four very small bones, furnished with muscles and joints. From the drum are several openings, one of which is to the mouth; the others communicate into the different recesses of the ear. One of these leads into the labyrinth which consists first, of a small irregular cavity, next of three semicircular canals, and lastly, of a winding spiral canal, not unlike some sea shells. All these parts of the cavity are lined with a very delicate membrane, and filled with a watery fluid, which conveys to the portions of the nerve in contact with it, the vibrations received from the membrane which separates the labyrinth from the drum of the ear. The vibrations of the air act upon the drum, and thus set in motion the series of small bones, in the cavity of the drum; these communicate the vibrations to the membrane which separates the drum from the labyrinth, and this (as before mentioned) produces vibrations in the watery fluid, in the several parts of the laybrinth, and conveys to the nervous branches, which line the laybrinth, the vibration originally produced on the drum. The mechanism is complicated, but what we understand must increase our reverential admiration of the skill which produced it.

To illustrate the cause of sound, it is to be observed, 1st, That a motion is necessary in the sonorous body for the production of sound. 2dly, That this motion exists first in the small and insensible parts of the sonorous bodies, and is excited in them by their mutual collision against each other, which produces the tremulous motion so observable in bodies that have a clear sound, as bells, musical chords, &c. 3dly, That this motion is communicated to, or produces a like motion in the air, or such parts of it as are fit to receive and propagate it. Lastly, That this motion must be communicated to those parts that are the proper and immediate instruments of hearing. The sonorous body having made its impression on the contiguous air, that impression is propagated from one particle to another, according to the laws of pneumatics. Sound travels through the air at a mean rate of about 13 miles in an hour.

SOUND, in geography, denotes in general any streight, or inlet, of the sea, between the two headlands.

SOUND-*board*, in an organ, is a reservoir into which the wind, drawn by the bellows, is conducted by a port-vent and hence distributed into the pipes placed over holes in its upper part.

SOUNDING, in navigation, the act of trying the depth of the water, and the quality of the bottom, by a line and plummet, or other artifice.

SOUP, a strong decoction of flesh, or other substances. Portable or dry soup is a kind of cake formed by boiling the gelatinous parts of animal substances till the watery parts are evaporated. This species of soup is chiefly used at sea, and has been found of great advantage.

SOUTHERNWOOD. See ARTEMISIA.

SOW, in the iron-works, the name of the block or lump of metal, they work at once in the iron-furnace.

SPACE, in geometry, denotes the area of any figure or that which fills the interval or distance between the lines that terminate it.

SPACE, in mechanics, the line a moveable body, considered as a point, is conceived to describe by its motion.

SPAN, a measure taken from the space between the thumb's end, and the tip of the little finger, when both are stretched out. The span is estimated at three hand's-breadths, or nine inches.

SPAR, in mineralogy, a name given to those earths which break easily into rhomboidal, cubical, or laminated fragments with polished surfaces.

SPARROW. See FRINGILLA.

SPARROW-HAWK. See FALCO.

SPARTIUM, *broom*, a genus of plants belonging to the class of diadelphia, and order of decandria, and in the natural system arranged under the 32d order, papilionaceæ. The calyx is produced downwards. There are 27 species.

SPATULA, an instrument used by surgeons, and apothecaries.

SPAYING, an operation performed on the females of several kinds of animals, to prevent any further conception, and promote their fattening.

SPEAKER *of the House of Commons*, a member of the house elected by a majority of the votes thereof, to act as chairman or president in putting questions, reading briefs or bills, keeping order, reprimanding the refractory, adjourning the house, &c.

SPECIES, in algebra, the characters or symbols made use of to represent quantities.

SPECIFIC, in medicine, a remedy whose virtue and effect is peculiarly adapted to some certain disease, is adequate thereto, and exerts its whole force immediately thereon.

SPECIFIC-*gravity*. See HYDROSTATICS.

SPECTRUM, in optics. When a ray of light is admitted through a small hole, and received on a white surface, it forms a luminous spot. See OPTICS.

SPECULATIVE, something relating to the theory of some art or science, in contradistinction to practical.

SPECULUM, a *looking-glass* or *mirror*, capable of reflecting the rays of the sun, &c.

SPERMACETI is found in the head of the Physeter macrocephalus, a species of whale; it is obtained in an unctuous mass, from which oil is obtained by expression. Spermaceti is also found in other cetaceous fishes, and in other parts of the body, mixed with the oil. It is a fine white substance of a crystalized texture, very brittle, and has little taste or smell. It crystalizes in the form of shining silvery plates.

SPHERE, is a solid contained under one uniform round surface, such as would be formed by the revolution of a circle about a diameter thereof as an axis.

Sphere, in astronomy, that concave orb, or expanse, which invests our globe, and in which the heavenly bodies appear to be fixed, and at an equal distance from the eye.

SPHERICS, the doctrine of the sphere, particularly of the several circles described on its surface, with the method of projecting the same on a plane.

SPHEROID, a solid body approaching to the figure of a sphere, though not exactly round, but having one of its diameters longer than the other.

SPHINX, the hawk moth, a genus of insects of the order lepidoptera. The generic character is, antennæ thickest in the middle, subprismatic, and attenuated at each extremity; wings deflected; flight strong, and commonly in the evening or morning.

SPICA VIRGINIS, a star of the first magnitude, in the constellation Virgo.

SPIDER. See Aranea.

SPIGELIA, *worm-grass*, a genus of plants belonging to the class of pentandria and order of monogynia; and in the natural system arranged under the 47th order, stellatæ.

SPIKING *up the ordnance*, a sea-phrase, used for fastening a quoin with spikes to the deck, close to the breech of the carriages of great guns, that they may keep close and firm to the ship's sides, and not get loose when the ship rolls, and by that means endanger the breaking out of a butt-head of a plank.

SPINACIA, *spinach*, a genus of plants belonging to the class of diœcia, and to the order of pentandria; and in the natural system arranged under the 12th order, holoraceæ.

SPINET, or Spinnet, a musical instrument ranked in the second or third place among harmonious instruments.

SPINNING, the act of reducing silk, flax, hemp, hair, wool, or other matter, into thread. Spinning is either performed on the wheel, or with a distaff and spindle, or with other machines proper for the several kinds of working.

SPINSTER, in law, an addition usually given to all unmarried women from a viscount's daughter downwards.

SPIRACULA, in entomology, holes or pores on each side of every segment of the abdomen, through which insects breathe.

SPIRAL, in geometry, a curve line of the circular kind, which, in its progress, recedes, from its centre.

SPLICING, in the sea language, is the untwisting the ends of two cables or ropes, and working the several strands into one another by a fid, so that they become as strong as if they were but one rope.

SPLINTER, a small shiver of wood, or the like. The splinters of fractured bones, if loose, are to be carefully removed, otherwise replaced.

SPONDYLUS, a genus of vermes testacea. The generic is, animal a tethys; shell hard, solid, with unequal valves; one of the valves convex, the other rather flat: hinge with two curved teeth, separated by a small hollow There are four species.

SPONGIA, *sponge*, in natural history; a genus of animals belonging to the class of vermes, and order of zoophyta. It is fixed, flexible, and very torpid, growing in a variety of forms, composed either of reticulated fibres, or masses of small spines interwoven together, and clothed with a living gelatinous flesh, full of small mouths or holes on its surface, by which it sucks in and throws out the water.

Fifty species have already been discovered, of which 10 belong to the British coasts.

SPONTANEOUS Combustion. It is now a well authenticated fact that many vegetable substances, highly dried and heaped together, will heat, scorch, and at last burst into flame. Of these, the most remarkable is a mixture of the expressed oil of the farinaceous seeds, as rape or linseed oil, with almost any dry vegetable fibre, such as hemp, cotton, matting, &c. and still more so, if also united with lamp black, or any other carbonaceous substance. These mixtures, if kept for a time undisturbed, in close bundles, and in a warm temperature, even in small quantities, will often heat, and burn with a smothered fire for some hours; and if air be admitted freely, will then burst into flame. To this may be attributed several accidental conflagrations in storehouses, and places where quantities of these substances are kept.

Several cases of death, from spontaneous combustion of the body, are on record. The appearance resemble those which would be produced by phosphuretted hydrogen.

SPRAT. See Clupea.

SPRING, in natural history, a fountain or source of water, rising out of the ground.

Spring, in mechanics, denotes a thin piece of tempered steel, or rather elastic substance, which, being wound up, serves to put several machines in motion by its elasticity, or endeavour to unbend itself: such is the spring of a clock, watch, &c.

SPRINGING *of a mast*, in the sea language, is when it cracks, but is not broken in any part of it: as the partners, hounds, &c.

SPRUCE-*beer*, a cheap and wholesome liquor, which is thus made: Take of water 16 gallons, and boil the half of it. Put the water thus boiled, while in full heat, to the cold part, which should be previously put into a barrel, or other vessel; then add sixteen pounds of treacle or molasses, with a few table-spoonful of the essence of spruce, stirring the whole well together; add half a pint of yeast, and keep it in a temperate situation, with the bung-hole open, for two days, till the fermentation is abated. Then close it up, or bottle it off, and it will be fit for being drunk in a few days afterwards.

SPUNGING, in gunnery, the cleaning a gun's inside with a sponge, in order to prevent any sparks of fire from remaining in her, which would endanger the life of him who should load her again.

SPUR, a piece of metal, consisting of two

rowel in form of a star, advancing out behind, to prick the horse.

SPY, a person hired to watch the actions, motions, &c. of another; particularly of what passes in a camp. When a spy is discovered, he is hanged immediately.

SQUADRON, in military affairs, denotes a body of horse whose number of men is not fixed; but is usually from one to two hundred. In naval affairs a squadron either implies a detachment of ships employed in any particular expedition, or one-third part of a naval armament.

SQUALUS, the *shark*, in natural history, a genus of fishes of the order cartilaginei. Generic character: mouth under the fore part of the head, with teeth disposed in rows, and partly moveable and partly fixed; generally five spiracles, at the sides of the neck, of a semilunar shape; body, oblong, rather cylindric and rough, with tender prickles. These animals are never found in rivers or lakes, inhabiting only the sea, and carrying terror and destruction wherever they appear. They grow, in some species, to the weight of three or four thousand pounds. They occasionally emit a phosphoric illumination, visible by night. They produce their young alive, several at a birth, but every one inclosed in a transparent hornlike substance, lengthened at the extremity into a thread, which attaches to fixed substances, such as rocks or weeds. Some appear to live on vegetables chiefly, but the greater number are rapacious of animal substances in the extreme. They seize, indeed, whatever they find, with the most violent avidity, following in the wakes of ships, for the sake of nearly every thing thrown from them, and are fatal to those mariners who slip from their hold on the rigging into the sea, in which case the sharks are seen to tear them to pieces, with all the violence of competition.

SQUARE. See GEOMETRY.

SQUARE *number*, the product of a number multiplied into itself.

SQUARE, *in the military art*, a particular formation into which troops are thrown on critical occasions: particularly to resist the charge of cavalry.

SQUARE, *solid*, is a body of foot, where both ranks and files are equal. It was formerly held in great esteem; but when the prince of Nassau introduced the hollow square, this was soon neglected.

SQUIRREL. See SCIURUS.

STAG. See CERVUS.

STAG BEETLE. See LUCANUS.

STALACTITES. These are found suspended from vaults, being formed by the oozing of water charged with calcareous particles, and gradually evaporating, leaving those particles behind.

STALK. See BOTANY.

STAMINA. See BOTANY.

STAMINA, in the animal body, are defined to be those simple original parts, which existed first in the embryo. See PHYSIOLOGY.

STAMP DUTIES, a branch of the public revenue, raised by requiring, that all deeds or documents, in order to be valid, shall be written on paper or parchment bearing a public mark or seal, for which a tax is paid.

STANDARD, in commerce, the original of a weight, measure or coin, committed to

trate, or deposited in some public place, to regulate, adjust, and try, the weights used by particular persons in traffic. The standards of weights and measures in England are appointed by Magna Charta to be kept in the exchequer, by a special officer, called the clerk, or comptroller of the market.

STANDARD, in war, a sort of banner, or flag, borne as a signal for the joining together of the several troops belonging to the same body.

The royal standard is a flag in which the imperial ensigns of England, Scotland, and Ireland, are quartered, together with the armorial bearings of Hanover.

STANDING, in the sea-language. Standing part of the sheet, is that part of it which is made fast to a ring at the ship's quarter. Standing part of a tackle, is the end of the rope where the block is fastened.

STANNARIES, the mines and works where tin is dug and purified, as in Cornwall, Devonshire, &c.

STAPLE primarily signifies a public place or market, whither merchants, &c. are obliged to bring their goods to be bought by the people, as the Greve, or the places along the Seine, for sale of wines and corn, at Paris, whither the merchants of other parts are obliged to bring those commodities. Formerly the merchants of England were obliged to carry their wool, cloth, lead, and other like staple-commodities of this realm, in order to utter the same by wholesale; and these staples were appointed to be constantly kept at York, Lincoln, Newcastle upon Tyne, Norwich, Westminster, Canterbury, Chichester, Winchester, Exeter, and Bristol; in each whereof a public mart was appointed to be kept, and each of them had a court of the mayor of the staple, for deciding differences, held according to the law-merchant, in a summary way.

STAR, in astronomy, a general name for all the heavenly bodies, which are dispersed throughout the whole heavens.

STAR *falling*, or *shooting star*, a luminous meteor darting rapidly through the air, and resembling a star falling. The explication of this phenomenon has puzzled all philosophers, till the modern discoveries in electricity have led to the most probable account of it. It is now allowed that this beautiful meteor is nothing more than an accumulation of electric matter passing through the nearer parts of the atmosphere.

STAR-BOARD, in the sea language, denotes the right-hand side of a ship.

STAR-SHOT, a gelatinous substance frequently found in fields, and is the half-digested food of herons, sea-mews, and the like birds; for these birds, when shot, have been found to disgorge a substance of the same kind.

STARCH. If a quantity of wheat-flour is formed into a paste, and then held under a very small stream of water, kneading continually till the water runs off from it colourless, the flour by this process is divided into two distinct constituents. A tough substance of a dirty-white colour, called gluten, remains in the hand; the water is at first milky, but soon deposits a white powder, which is known by the name of starch.

STATICE, *thrift*, a genus of plants belonging to the class of pentandria, and order

of pentagynia; and in the natural system ranging under the forty-eighth order, aggregate.

STATICS, that branch of mathematics which considers the motion of bodies arising from gravity.

STATIONERS. This extensive and highly respectable branch of trade, is said to have been so called from the circumstance of the traffic in books, paper, &c. having formerly been so inconsiderable, that those who dealt in such articles had no shops, but only stalls and stands in the streets.

STATISTICS, a word lately introduced to express a view or survey of any kingdom, county, or parish.

STATUARY, a branch of sculpture, employed in the making of statues.

STATUES, are figures, representing living or deceased creatures, of whatever species, real or imaginary; and carved, cast, modelled, or moulded, in full relievo, insulated on every part. Statues are formed with the chisel, of several materials, such as marble, stone, &c.; they are carved in wood, or cast in plaster of Paris, or other matter of a similar nature: they are also often cast in various kinds of metals.

STATUTE, in its general sense, signifies a law, ordinance, decree, &c. Statute, in our laws and customs, more immediately signifies an act of parliament made by the three estates of the realm; and such statutes are either public, of which the courts at Westminster must take notice, without pleading them; or they are special and private, which last must be pleaded.

Statutes, or *statutes sessions*, otherwise called petit sessions, are a meeting in every hundred, of all the shires in England, where by custom they have been used, whereto the constables and others, both house-holders and servants, repair for the debating of conferences between masters and servants, the rating of servants' wages, and bestowing such people in service, as being fit to serve, either refuse to seek or get masters.

STAVE, in music, the five horizontal and parallel lines on and between which the notes are placed.

STAUROLITE, in mineralogy. This stone has been found at Andresberg, in the Hartz. It is crystallized, and the form of its crystals has induced mineralogists to give it the name of cross-stone. Its crystals are two four sided flattened prisms, terminated by four sided pyramids, intersecting each other at right angles; the plane of intersection passing longitudinally through the prism.

STEALING, the fraudulent taking away of another man's goods, with an intent to steal them, against or without the will of him whose goods they are.

STEAM, a term used to designate the vapour produced by the application of heat to fluid bodies.

Steam Engine. The steam engine has with great propriety been denominated the triumph of mechanics. It is an engine now widely used, wherever great power is wanted; and this power is produced by giving a mechanical direction to the steam or vapour of boiling water.

The merit of this grand invention is generally attributed to the Marquis of Worcester; but if the first idea originated with him, the perfecting of it belongs to the immortal James Watt, a native of Greenock. The improvements that have been made in the construction of the steam engine within the last twenty years, are so numerous, that in our little work it would be preposterous to attempt to describe them. We shall therefore content ourselves with giving our readers a brief description, and a representation of a modern steam engine, which may, of course, be constructed of any required power, and applied to any purpose.

In plate XLVII, A, represents a wrought iron boiler, about three parts filled with water; the bottom is considerably, and the sides a little, concave, that it may receive more fully the force of the flame circulating round it. Boilers are usually of an oblong form, and are furnished with a part that takes off, in order that a person may get in to clean them when needful; they have also a valve, called the safety-valve, opening upwards, which is loaded so that the steam escapes when it is stronger than the engine requires, and, if retained, would hazard the bursting of the boiler. It is not uncommon to have two boilers, one of which is a reserve, that the engine may not be stopped, when the other requires repair.

B, is an apparatus for regulating the fire, and giving action to a bell, which regulates the quantity of coals and time of firing.

C, the steam-pipe from the boiler A to the valve I.

D, the steam cylinder, generally called only "the cylinder;" it is connected at the top and bottom with the valve I.

E, the piston, which, by its connecting rod *e*, gives motion to the beam F, the other end of which, by another connecting rod, gives motion to the heavy fly-wheel G, by means of a crank. Thus, after the engine has begun to work, its power is accumulated in the fly-wheel, and may be disposed of at the pleasure of the mechanist.

H, an eccentric circle on the axle of the fly-wheel G; it gives motion by its levers, to the valve I.

I, a coffer-slide valve, which requires no packing to make it steam-tight, as there is always a vacuum under it: it answers the purpose of the four valves used in double-power engines, and from the simplicity of its construction, when well made at first, is not liable to get out of order.

K, the steam-admission valve and lever, connected with a governor, which regulates the speed of the engine.

L, the cylinder of the discharging pump, for extracting the water and uncondensed vapour from the condenser M.

N, a small cistern, filled with water. Into this cistern enters a pipe from the condenser M, the top of which pipe is covered by a valve, which is called the blow-valve, sometimes the shifting valve. Through this valve the air contained in the cylinder D, and passages from it, is discharged, previously to the engine being set in motion.

O, the eduction-pipe, which conducts the steam from the valve I to the condenser M.

P, the pump which supplies with water the cistern SS. in which the condenser and discharging pump stand.

QQ, iron columns, of which the engine has

four, although only two are shewn; they stand upon one entire plate seen edgeway, on which the principal parts of the engine are fixed; by this means the beam and its accompaniments are supported without being connected with any part of the building, except the recess below the floor on which they stand.

RR, the recess below the floor, for containing the cistern of the discharging-pump, condenser, &c. This arrangement enables those engines to be fixed up and tried at the manufactory before they are sent off, which renders the refixing easy and certain.

Before the engine is set to work, the cylinder D, the condenser M, and the passages between them, are filled with common air, which it is necessary to extract. To effect this, by opening the valves, a communication is made between the steam-pipe C, the space below the piston in the cylinder D, the eduction-pipe O, and the condenser M. The steam will not at first enter the cylinder D, or will only enter it a little way, because it is resisted by the air; but the air in the eduction-pipe O, and the condenser M, it forcibly drives before it, and this part of the air makes its exit through the valve and water in the cistern N. The steam-admission valve is now closed, and the steam already admitted is converted into water, partly by the coldness of the condenser M, but principally by a jet of cold water which enters it through a cock opening into it from the well SS, in which the condenser is immersed. When this steam is condensed, all the space it occupied would be a vacuum, did not the air in the cylinder D expand, and fill all the space that the original quantity of it filled; but by the repetition of the means for extracting a part of the air, the remainder is blown out, and the cylinder becomes filled with steam alone. Suppose then the cylinder beneath the piston to be filled with steam, and the further admission of steam to that part of it be cut off, while the communication between it and the condenser remains open, it is obvious that there will soon be a vacuum in the cylinder, because as fast as the steam reaches the condenser, it is converted into water by the coldness of that vessel and the jet playing within it. At this moment, therefore, the steam is admitted above the piston, which it immediately presses down. As soon as the piston reaches to the bottom of the cylinder, the steam is admitted to the under side of it; and as the communication from the upper side of the piston to the condenser is opened, while the further admission of steam to that side during the upper stroke, is prevented, the steam which had pressed the piston down passes into the condenser, and is converted into water.

The motion of the piston E, by this alternate admission and extraction of the steam on each side of it, is thus necessarily continued, and the distance of its upward and downward range is called the length of its stroke. It communicates its reciprocating motion, by the connecting rod *e*, to the great beam F, and thence, by another connecting-rod and a crank, to the fly-wheel G.

To explain the rapid accumulation of power with an increase of the size of the engine, it must be observed, that the force of the steam generally used, is somewhat greater than the pressure of the atmosphere; but supposing it to be no greater, as the atmospheric pressure is fifteen pounds on each square inch, a piston 16 inches in diameter, containing 201 square inches of surface, will alternately be raised and depressed by a force equivalent to a weight of 3015 pounds. Here no allowance is made for friction, but after the requisite deduction on this account, which may be reckoned at one-third, the disposable part of the engine, derived from each stroke, will still be very great.

The condenser M, and the discharging-pump L, communicate by means of a horizontal pipe containing a valve *y* opening towards the pump; the piston, *l*, of this pump, also contains two valves, and the cistern T, at the top of the pump-cylinder, contains other two valves, which, like those of the piston *l*, open upwards. When the piston E of the cylinder is depressed, the piston *l*, of the discharging-pump, it will be obvious to inspection, is depressed likewise, and its valves open, while the valve *y* closes; hence the water from the condensed steam, as well as the injection-water, and any permanently elastic vapour or gas, which may be present, having passed through the valve *y*, passes through the piston *l*: and when that piston is drawn up, its valves close, and prevent their return, as in ordinary pump-work. The water and gas that have thus got above the piston, as the latter rises, open the valves at the bottom of the cistern T, in which the water remains till it is full, but the gas passes into the atmosphere. As the water in the cistern T is in a very hot state, it is sometimes, for the purpose of economizing fuel, pumped up, and returned to the boiler, the pump-rod being attached to the great beam. The utility of the discharging-pump L, will now be appreciated, and it must be perceived how much mo[illegible] materially it contributes to the perfection of the vacuum in the cylinder D, than if the water from the condenser merely ran off by a pipe.

The steam constantly rushing into the condenser M, has a perpetual tendency to heat that vessel, as well as the water of the cistern SS, in which it stands: the whole of the steam, if this were unchecked, would not be condensed, or the condensation would not be sufficiently rapid, because the injection-water itself flows out of this cistern. A part of the water is therefore allowed to flow from this cistern by a waste pipe, and an equal quantity of cold is constantly supplied by the pump P.

In Newcomen's engine, which, as it acted by the pressure of the atmosphere, is often called an atmospherical engine, the cylinder was open at the top, and therefore, during the descent of the piston, the air exerted a great power in cooling it; but in the modern engines, where steam is the active power both in raising and depressing the piston, the top of the cylinder is closed with an iron lid, and not an atom of steam can escape, except at the proper time, into the condenser. In order that the connecting rod *e*, may work freely, and yet possess this desirable property of being steam-tight, it passes through what is called a *stuffing* or *packing box*. This stuffing consists of some material which the steam will rather adapt to its office than injure: leather, which is used for the stuffing or collars of machines

never to be subjected to heat, will not answer here; hempen yarn is the material usually employed. The rod of the piston *l*, passes through a stuffing box of the same kind as that of the piston E; and the pistons themselves are surrounded with stuffing.

The cylinder D is surrounded by a case, to keep it from being cooled by contact with the external air. The extremity, or any given point removed from the centre of the great beam, can describe only the arc of a circle; but it is necessary that the piston rod *e* should rise and fall vertically. Newcomen effected this object, by fixing the end of the beam into the arc of a circle, the radius of which was equal to the distance from the centre of the beam: a chain went over this arc, and was fastened on the higher end of it; this simple contrivance effectually answered his purpose, because in his engine the effective stroke was only downwards; but here, in a double-power engine, where the stroke is both upwards and downwards, a chain would yield in rising, and be altogether unsuitable. An apparatus is therefore used, called the parallel joint, which is easily understood by inspection. By this means the rod *e*, not only rises and falls perpendicularly, but is perfectly rigid, and communicates all its motion to the great beam in each direction of its motion. The connecting rod *g* does not require the same contrivance, because it does not rise and fall perpendicularly; its lower end, with the outer end of the crank, describing a circle: it has therefore only a simple joint, admitting of this deviation.

STEEL, a carburet of iron, or that metal combined with a small portion of carbon. See Iron.

STEERAGE, on board a ship, that part of the ship next below the quarter-deck, before the bulk-head of the great cabin, where the steersman stands in most ships of war.

STEERING, in navigation, the directing a vessel from one place to another by means of the helm and rudder. He is held the best steersman who causes the least motion in putting the helm over to and again, and who best keeps the ship from making yaws, that is, from running in and out. The perfection of steering, indeed, consists in a vigilant attention to the motion of a ship's head, so as to check every deviation from the line of her course in the first instant of motion, and in applying as little of the power of the helm as possible.

STEM, in botany, that part of a plant arising out of the root, and which sustains the leaves, flowers, fruits, &c.

Stem *of a ship*, that main piece of timber which comes bending from the keel below, where it is scarfed, as they call it; that is, pieced in; and rises compassing right before the forecastle.

STENOGRAPHY, or the art of short-hand writing, is an acquirement which, in the present advanced state of literature and science, every person who receives even a common education, ought to possess. Of the various systems of short-hand writing now before the public, the following is here preferred for its great simplicity; the facility with which the characters may be joined; and the ease with which it may be read when written.

The author of this system was John Byrom, M. A. and F. R. S.; and it was since Byrom's time improved by Mr. Molineux, of Macclesfield. The general fault of most short-hand alphabets is their being encumbered with vowels as distinct letters; in this system they are expressed by one dot, *differently situated*; but the student is advised to reject the use of them altogether, unless, indeed, in cases where they are necessary to prevent ambiguity.

A close attention to the plates, and the few following remarks, will enable any one accustomed to writing, speedily to become acquainted with this most useful art.

The alphabet, as exhibited in the plate, consists of the shortest and simplest marks in nature; and on the proper formation and combination of these, depend the whole beauty and accuracy of the writing.

The twenty-one consonants which compose the short-hand alphabet, are formed out of simple lines, to some of which are attached small loops or twirls. These lines derive their respective powers and properties from their difference of position, and by some of them being made curvilineal.

The horizontal characters are always to be written from left to right; the perpendicular ones are invariably written downwards; and with respect to the oblique characters, it is to be observed, that those which lean to the left are generally written upwards, while those having their inclination to the right hand, are always written downwards.

Not any of the twirled letters (the duplicate characters denoting *h, j, w,* and *sh,* which are never joined to any other letters; but simply stand for the words *had, just, would,* and *should,* excepted) ought ever to be written so as to end with the loop. This observation must not be forgotten by the learner, and he will never be at a loss about the manner of joining the looped characters to other letters.

The following general rules must be carefully attended to by the short hand writer, viz.:

1. All perpendicular and inclined letters are made to touch, as it were, to imaginary parallel lines, the distance of which from each other is supposed to be regulated by the length of the short hand *t*.
2. The diameter of the semicircular letters is the short-hand *s*, and their height rather more than one third of the *t*.
3. The *t* is occasionally used for *th*, in which case the adjoining letter must be made only half its regular size.
4. No letters are to be doubled in short-hand unless some vowel come between them.
5. When there are various ways of joining the same letters together, that which is most lineal must be preferred.

As soon as the learner can write any passage with readiness, using the characters in full, he may proceed to the following abbreviated method, which he will find both advantageous and delightful; and which will enable *him* with a little industrious practice to follow the most rapid speaker.

RULES OF ABBREVIATION.

For the short-hand characters answering to the examples in the following rules the reader must refer to Plate XLIX.

1. The auxiliary verbs, the participle *not* and the pronouns, being severally denoted by

their first consonant, may be joined to one another; as *can be, will be, have not been.*

2. Join the marks or letters in an unusual manner, in order to show that each particular mark denotes a word, and not a single letter; as, by joining the letter *n* to the middle instead of the top of the letter *t*, the whole character will represent the words *in the;* so, also, the letter *s*, joined to the letter *t*, and drawn from the middle of the preceding consonant, will denote the two words *it is*, or *it was.*

3. Derivative nouns, adjectives, and adverbs, may be very conveniently expressed by points, differently placed, at the end of their last consonant. The substantive point being placed immediately following the consonant, and in a direct line with it; the adjective to have its point placed also a little lower down to the left of the substantive point; and the adverb point to be placed, in the same manner, to the right of the substantive point; as *forgetfulness, forgetful, forgetfully.*

4. Very common words, or such as have an immediate relation to the subject, and are therefore easily discoverable, may be denoted by their first consonant, or first vowel and consonant, with the substantive, adjective, or adverb point annexed. The adjectives, which usually accompany such substantives, may also be denoted by their first consonant, joined to the substantive; as *humble servant, human nature, Christian religion*, &c.

5. Place a dot at the point of concurrence of two consonant marks, to denote two substantives connected together by some preposition, which is omitted; as *love of God*, or *light of the gospel*; *cause of gravity*, &c. Also when an adjective precedes either of the substantives, they may all three be represented by their first consonants joined together, with the dot placed at the end of the first substantive; as the *great goodness of God.*

6. The substantive point, placed before a single consonant mark, denotes that the substantive is to be repeated, with some intervening preposition; as *day after day*; from *time to time*, &c.

7. Place the substantive, adjective, or adverb point before two or more consonant marks, to denote two or more substantives, adjectives or adverbs, connected by a conjunction; as *King, Lords*, and *Commons, soberly, righteously*, and *godly*, &c.

8. Express long words by their first syllable with as many points annexed as there are syllables wanting. In very common words the points may be occasionally omitted.

9. Express long words by their prepositions, together with their next vowel or consonant only.

10. Words may be denoted by their first vowel and consonant, with their terminations added; as *arbitrary, opportunity*, &c.

11. Words easily discovered by their connection, may be expressed by their first vowel and consonant, or by their prepositions only; and as few English words end with the syllable *to*, the preposition *to* may be joined to the preceding word; as *belongs to*; *satisfactory to*, &c.

12. Join the pronouns to prepositions; as *to me, to us, to you*, &c., always adding the vowel point, when the words would otherwise be liable to be mistaken.

13. Join the preceding word, the preposition, and pronoun all together; as *belongs to me agreed with me*, &c.

14. Join adverbs, verbs, prepositions, pronominal adjectives, and substantives all together; as *safely depend upon my word*, &c.

15. Many common phrases, formed by substantive, preceded by the prepositions *with, without, in*, &c. and followed by *to, of*, &c. may be abbreviated; as *with regard to*; *in consequence of*, &c. These several words are expressed by their first consonants only, joined together, the vowel *o* being added in the first example to denote the preposition *to.*

16. In like manner, denote common adverbial phrases by the initial consonants joined together; as *in like manner*; *in particular*; *in a great measure*, &c.

17. Numerous contractions may be made when *it is*, or *it was*, are followed by an adjective, and *to*, or *that*; as *it is impossible to*; *it is not to be supposed that*, &c.

18. The termination *ing* is made by a short line in the position of the *r*, and the plural by two such lines   *king, kings*; *writing, writings.*

STEREOGRAPHY, the art of drawing the forms and figures of the solids upon a plane.

STEREOTYPE PRINTING. See PRINTING.

STERLING, a term frequent in British commerce. A pound, shilling, or penny, sterling, signifies as much as a pound, shilling, or penny, of lawful money of Great Britain, as settled by authority.

STERN *of a ship*, usually denotes all the hindermost part of her, but properly it is only the aftmost part abaft.

STERNA, *the tern*, a genus of birds of the order anseres. The marks of this genus are a straight, slender, pointed bill, linear nostrils, a slender and sharp tongue, very long wings, a small back toe, and a forked tail. There are 25 species.

STEWARD, a man appointed in a place or stead, and always signifies a principal officer within his jurisdiction.

STICK, the same as baton, an instrument of dignity, which is occasionally carried by persons and officers in high situations, particularly by such as are in waiting near the royal person.

STIGMA, in botany, the summit of the style, the female organ of generation in plants, which receives the fecundating dust of the tops of the stamina, and transmits its effluvia through the style into the heart of the seed-bud, for the purpose of impregnating the seeds.

STILL. See DISTILLATION.

STING, an apparatus in the body of certain insects, in form of a little spear, serving them as a weapon of offence.

STOCKING, that part of the clothing of the leg and foot which immediately covers their nudity, and screens them from the cold, &c. Anciently, the only stockings in use were made of cloth, or of milled stuffs sewed together; but since the invention of knitting and weaving stockings of silk, wool, cotton, thread, &c. the use of cloth stockings is quite laid aside. The modern stockings, whether woven or knit, are a kind of plexuses, formed of an infinite number of little knots, called stitches, loops, or meshes, intermingled in one another.

STOCKS, or *Public Funds in England.* By the word stock was originally meant a particu

lar sum of money contributed to the establishing of a fund to enable a company to carry on a certain trade, by means of which the person became a partner in that trade, and received a share of the profit made thereby, in proportion to the money employed.

Stocks, among ship-carpenters, a frame of timber, and great posts made ashore, to build pinnaces, ketches, boats, and such small craft, and sometimes small frigates. Hence we say, a ship is on the stocks when she is a building.

Stocks, a wooden machine to put the legs of offenders in, for the securing of disorderly persons, and by the way of punishment in divers cases, ordained by statute, &c.

STOLE, *groom of the*, the eldest gentleman of his majesty's bed-chamber, whose office and honour it is to present and put on his majesty's first garment, or shirt, every morning, and to order the things in the chamber.

STOMOXYS, a genus of insects of the order diptera: the generic character is, sucker with a single-valved sheath, inclosing bristles, each in its proper sheath; feelers two, short, setaceous, of five articulations; antennæ setaceous.

STONES and EARTHS. The only substances which enter into the composition of the simple stones, as far at least as analysis has discovered, are the six earths, silica, alumina, zirconia, glucina, lime, and magnesia; and the oxides of iron, manganese, nickel, chromium, and copper. Seldom more than four or five of these substances are found combined together in the same stone.

STONEHENGE, a famed pile or monument of huge stones on Salisbury Plain, six miles distant from that city. It consists of the remains of four ranks of rough stones, ranged one within another, some of them, especially in the outermost and third rank, twenty feet high, and seven broad; sustaining others laid across their heads and fastened by mortices, so that the whole must have anciently hung together. Antiquaries are now pretty well agreed that it was a British temple.

STONE WARE. Under the denomination stone ware are comprehended all the different artificial combinations of earthy bodies which are applied to useful purposes.

STOP, in music, a word applied by violin and violoncello performers to that pressure of the strings by which they are brought into contact with the finger-board, and by which the pitch of the note is determined.

STOP, TRUMPET. A reed metallic stop, so called because its tone is imitative of the trumpet.

STORES. If any person who has the charge or custody of any of the king's armour, ordnance, ammunition, shot, powder, or habiliments of war, or of any victuals for victualling the navy, shall, to hinder his majesty's service, embezzle, purloin, or convey away the same to the value of 20*s.* or shall steal or embezzle any of his majesty's sails, cordage, or any other of his naval stores, to the value of 20*s.* he shall be adjudged guilty of felony without benefit of clergy.

STRANDED, among seamen, is said of a ship that is driven ashore by a tempest, or runs on ground through ill steerage, and so perishes.

STRATA, in natural history, the several beds or layers of different matters, whereof the body of the earth is composed.

STRIKE, a measure of capacity, containing four bushels.

Strike, among seamen, is a word variously used. When a ship, in a fight, or on meeting with a ship of war, lets down or lowers her topsails, at least half-mast-high, they say she strikes, meaning she yields, or submits, or pays respect to the ship of war. Also, when a ship touches ground, in shoal-water, they say she strikes. And when a top-mast is to be taken down, the word of command is, strike the top-mast, &c.

STRIX, the *owl*, in ornithology, a genus belonging to the order of accipitres. The bill is hooked, but has no cere or wax; the nostrils are covered with setaceous feathers; the head is very large, as are also the ears and eyes; and the tongue is bifid. There are 46 species.

STRONTIAN. About the year 1737, a mineral was brought to Edinburgh by a dealer in fossils, from the lead mine of Strontian, in Argyleshire, where it is found imbedded in the ore, mixed with several other substances. It is sometimes transparent and colourless, but generally has a tinge of yellow or green. Its specific gravity varies from 3.4 to 3.726. Its texture is generally fibrous; and sometimes it is found crystallized in slender prismatic columns of various lengths. Strontian is found abundantly in different places of the world, and always combined with carbonic acid or sulphuric acid.

The beautiful red fire which is now so frequently used at the theatres, is composed of the following ingredients 40 parts dry nitrate of strontian, 13 parts of finely powdered sulphur, 5 parts of chlorate of potash, (hyperoxymuriate) and 4 parts of sulphuret of antimony. The chlorate of potash and sulphuret of antimony should be powdered separately in a mortar, and then mixed together on paper, after which they may be added to the other ingredients, previously powdered and mixed. No other kind of mixture than rubbing together on paper is required. See Chemistry.

STRUTHIO, the *ostrich*. The ostrich has a bill somewhat conical; the wings are so short as to be unfit for flying; the thighs and sides of the body are naked: the feet are formed for running, having two toes, one only of which is furnished with a nail. The head and bill somewhat resemble those of a duck; and the neck may be likened to that of a swan, but that it is much longer; the legs and thighs resemble those of a hen, though the whole appearance bears a strong resemblance to that of a camel. But though usually seven feet high from the top of the head to the ground, from the back it is only four; so that the head and neck are above three feet long.

From the top of the head to the rump, when the neck is stretched out in a right line, it is six feet long, and the tail is about a foot more One of the wings without the feathers, is a foot and a half; and being stretched out, with the feathers, is three feet. The plumage is much alike in all; that is, generally black and white; though some of them are said to be grey. There are no feathers on the sides, nor yet on the thighs, nor under the wings. The lower part of the neck, about half-way, is covered with

still smaller feathers than those of the belly and back, and these also are of different colours. At the end of each wing there is a kind of spur almost like the quill of a porcupine. It is an inch long, being hollow and of a horny substance. There are two of these on each wing; the largest of which is at the extremity of the bone of the wing, and the other a foot lower. The neck seems to be more slender in proportion to that of other birds, from its not being furnished with feathers. The skin in this part is of a livid flesh-colour. The bill is short and pointed. The external form of the eye is like that of a man, the upper eye-lid being adorned with eye-lashes which are longer than those on the lid below. The tongue is small, very short, and composed of cartilages, ligaments, and membranes, intermixed with fleshy fibres. In some it is about an inch long, and very thick at the bottom; in others it is but half an inch, being a little forked at the end.

The ostrich is a native only of the torrid regions of Africa, and has long been celebrated by those who have had occasion to mention the animals of that region.

STRUTHIOLA, a genus of plants belonging to the class of tetrandria, and order of monogynia. The species are five, shrubs of the Cape.

STUCCO, in building, a composition of white marble pulverised, and mixed with plaster of lime; and the whole being sifted and wrought up with water, is to be used like common plaster: this is called by Pliny marmoratum opus, and albarium opus.

STUM, in the wine trade, denotes the unfermented juice of the grape, after it has been several times racked off, and separated fro its sediment.

STURGEON. See ACCIPENSER.

STYLE, a word of various significations, originally derived from ςυλος, a kind of bodkin, with which the ancients wrote on plates of lead, or on wax, &c. and which is still used to write on ivory leaves, and paper prepared for that purpose, &c.

SUBALTERN, a subordinate officer, or one who discharges his post under the command and subject to the direction of another; such are lieutenants, sub-lieutenants, cornets, and ensigns who serve under the captain, but custom has now appropriated the term to those of much lower rank, as serjeants, &c.

SUBER. This name has been introduced into chemistry by Fourcroy, to denote the outer bark of the quercus suber, or the common cork, a substance which possesses properties different from all other vegetable bodies.

SUBLIMATION is a process by which volatile substances are raised by heat, and again condensed in the solid form.

This operation is founded on the same principles as distillation, and its rules are the same, as it is nothing but a dry distillation.

SUBPŒNA, is a writ whereby all persons under the degree of peers are called into Chancery, in such cases only where the common law fails, and has made no provision; so as the party who in equity hath wrong, can have no other remedy by the rules and course of common law.

SUBSIDY, in law, signifies aid or tax granted to the king, by parliament, for the necessary occasions of the kingdom; and is to be levied on every subject of ability, according to the rate or value of his lands or goods.

SUCCINIC ACID. It has long been known that amber, when exposed to distillation, affords a crystallized substance, which sublimes into the upper part of the vessel. Before its nature was understood it was called *salt of amber*: but it is now known to be a peculiar acid, as Boyle first discovered.

SUGAR exists in every part of plants. It is found in the roots, as those of the carrot and beet root; in the stems, as in the birch, the maple, some palms, and especially the sugar cane; in the leaves, as those of the ash; in the flowers, the fruits, and seeds. But the sugar, which now forms a very extensive article of commerce, and may be considered as a necessary of life, is entirely obtained from the juice of the sugar cane, which is chiefly cultivated in the East and West Indies

SUGAR *of lead*, acetate of lead.

SUIT, in law, is used in different senses, as. 1. Suit personal. 2. Suit of court, or suit service, is an attendance that tenants owe to the court of their lord. 3. Suit covenant, is where the ancestor has covenanted with other, to sue to his court. 4 Suit custom, when a man and his ancestors have been seized time out of mind, of his suit. 5. Suit real, or legal, when men come to the Sheriff's torn or leet. 6. Suit signifies the following one in chace, as fresh suit. 7. It signifies a petition made to the king or any great person.

SULPHATES. Definite compounds of sulphuric acid with the salifiable bases. See ACID (SULPHURIC,) and the respective bases.

SULPHITES. Definite compounds of sulphurous acid with the bases.

SULPHUR. See CHEMISTRY.

SULPHURIC ACID. The sulphuric acid made in Great Britain is produced by the combustion of sulphur. There are three conditions requisite in this operation. Oxygen must be present to maintain this combustion; the vessel must be so close as to prevent the escape of the volatile matter which rises, and water must be present to imbibe it. For these purposes, a mixture of eight parts of sulphur with one of nitre is placed in a proper vessel, enclosed within a chamber of considerable size, lined on all sides with lead, and covered at bottom with a shallow stratum of water. The mixture being set on fire, will burn for a considerable time by virtue of the supply of oxygen which nitre gives out when heated, and the water imbibing the sulphurous vapours, becomes gradually more and more acid after repeated combustions, and the acid is afterward concentrated by distillation.

SUMACH. Common sumach (rhus coriaria) is a shrub that grows naturally in Syria, Palestine, Spain, and Portugal. In the two last, it is cultivated with great care. Its shoots are cut down every year quite to the root; and, after being dried, they are reduced to power by a mill, and thus prepared for the purposes of dyeing and tanning.

SUPERCARGO, a person employed by merchants to go a voyage, and oversee their cargo, or lading, and dispose of it to the best advantage.

SUPERNUMERARY, something over and above a fixed number. In several of the offices

are supernumerary clerks, to be ready on extraordinary occasions. There are also supernumerary surveyors of the excise, to be ready to supply vacancies when they fall; these have but half-pay.

SUPERSEDEAS, a writ that lies in a great many cases, and signifies, in general, a command to stay proceedings, on good cause shown, which ought otherwise to proceed. By a supersedeas, the doing of a thing which might otherwise have been lawfully done, is prevented; or a thing that has been done, is (notwithstanding it was done in a due course of law) thereby made void.

SURD. See ALGEBRA.

SURETY, in law, generally signifies the same with bail.

SURETY *of the peace*. A justice of the peace may, according to his discretion, bind all those to keep the peace, who, in his presence shall make any affray, or shall threaten to kill or beat any person, or shall contend together in hot words; and all those who shall go about with unlawful weapons or attendance to the terror of the people; and all such persons as shall be known by him to be common barrators; and all who shall be brought before him by a constable for a breach of the peace in the presence of such constable: and all such persons who, having been before bound to keep the peace, shall be convicted of having forfeited their recognizance.

SURGERY, is the art of curing or alleviating diseases by local and external application, manual or instrumental. As a science it may be defined, that department of medicine which treats of maladies thus susceptible of alleviation or cure.

SURRENDER, a deed or instrument, testifying that the particular tenant of lands or tenements for life, or years, does sufficiently consent and agree, that he who has the next or immediate remainder or reversion thereof, shall also have the present estate of the same in possession; and that he yields and gives up the same to him; for every surrenderer ought forthwith to give possession of the thing surrendered.

SURROGATE, one who is substituted or appointed in the room of another; as the bishop or chancellor's surrogate.

SURVEYING. The art of land surveying consists in determining the boundaries of an extended surface; and when used in its most extensive sense, may be said to comprehend the taking the dimensions of any given tract of land; laying down the same in a plan on any required scale; and finding the superficial contents, or area of the same. The principal instruments used by surveyors are the chain, the off-set staff, the plain-table, the cross, and the theodolite. The plain-table is now little used; it is found often incorrect; and he who would operate correctly ought to be in possession of a good four inch theodolite, having on it at least two spirit levels.

It was our intention to have laid down some general rules for the practice of surveying and to have given some examples; but we find our limits will not admit of this; and we must, therefore, refer our readers for the necessary information on this subject, to the popular treatises on it which are now before the public; among which, that of Croker, and the excellent epitome given by Mr. Peter Nicholson in his Course of Mathematics, deserve particular attention.

The foundation of all surveying is geometry; and no one will ever be able to practice it to any extent without a knowledge of the principal rules of plane trigonometry, which see.

SUS, the *hog*, in natural history, a genus of mammalia, of the order of belluæ. Generic character: four front teeth in the upper jaw, converging; six in the lower, projecting; two tusks in the upper jaw, short; two in the lower standing out; snout truncate, prominent, and moveable: feet cloven. These animals are allied by their teeth to the carnivorous quadrupeds, and by their cloven feet to the ruminating ones. They feed almost indifferently upon animal and vegetable substances, devouring with avidity what is most nauseous and disgusting. They use their snout for digging up the ground in quest of roots, are fond of rolling and wallowing in mud, and are distinguished by extreme fecundity. There are six species, of which the following are the most important:

Sus, crofa, the common hog. All the varieties of this animal originate in the wild boar, which is found in most of the temperate regions of Europe and Asia. It is smaller than the domesticated animal, and uniformly of a dark grey colour, approaching to black. It is armed with formidable tusks, sometimes ten inches, or even more, in length; those in the under jaw curving inwards, and capable from their size, strength, and sharpness, of inflicting the severest wounds. Before these animals attain their third year they are gregarious, and when danger is at hand particularly, they muster in numerous parties, and with great promptitude, at the signal of alarm. Uniting thus, they present so formidable an array, as speedily to disperse the enemy, few creatures, or none, daring to commence an attack against such a combination of strength and valour as they exhibit. When the wild boar is complete in growth, he depends upon his solitary exertions for his protection, is seldom seen in society, ranging the forests alone; rarely commencing an attack, as his food consists almost solely of roots and vegetables, but repelling one with all the fierceness of courage, and all the resentment of rataliation.

Sus, Ethiopicus, or the Ethiopian hog, is very similar to the last. It is fierce and formidable in the highest degree, and burrows in the ground, in deep recesses which it prepares with both its hoofs and nose. It is particularly distinguished by a large lobe, or wattle, beneath each eye.

S. baby-roussa is remarkable for the form and situation of the upper tusks, which are placed externally, and turn upwards in a curve towards the forehead. It abounds in the Indian islands, lives solely on vegetables, and rests itself, in sleep, by hooking its upper tusks round the branch of a tree. It can swim with rapidity, and is valued for food.

SUSPENSION, or POINTS of SUSPENSION, in mechanics, are those points in the axis or beam of a balance, wherein the weights are applied, or from which they are suspended.

SWEDENBORGIANS a term used to designate the receivers of the doctrines taught

by the Hon. Emanuel Swedenborg, a native of Sweden. They form a highly respectable, and remarkably intelligent body of Christians. Since the death of Swedenborg, which took place in London, in the year 1772, their numbers have gradually increased, both in this country, on the continent, and in America. They have suffered much from ignorant and interested misrepresentation; and it is a remarkable fact, that the writings of their founder have never been attacked by any man of talent, if we except Dr. Priestley, who, in the attempt, met with a most signal defeat, by Mr. Hindmarsh, of Manchester. Among the admirers of the works of Swedenborg, might be mentioned several eminent divines, and numerous members of the Church of England. While the various sects into which the Christian world is divided, are zealously exerting themselves for the diffusion of religious knowledge, the Swedenborgians are far from being idle. They have their schools for the instruction of the rising generation, their Missionary and Tract Societies, and also societies for printing and publishing the theological writings of Swedenborg. Their exertions have excited considerable attention in this country within the last few years. The consequence of this has been some most illiberal attacks on their doctrines by some dissenting ministers. These have drawn forth a reply from Mr. Samuel Noble, minister of Hanover-street Chapel, London, to which we refer the reader for a most interesting and able detail of the principles and practice of this body of Christians.

SWIETENIA, *mahogany*, a genus of plants belonging to the class of decandria, and to the order of monogynia; and in the natural system arranged under the 54th order, miscellaneæ. There are three species: the mahogany, which is the principal, is a native of the warmest parts of America, and grows also in the island of Cuba, Jamaica, Hispaniola, and the Bahama islands. It abounded formerly in the low lands of Jamaica, but it is now found only on high hills and places difficult of access.

SWIMMING, the act of sustaining the body in water, and of moving in it, in which action the air-bladder and fins of fishes bear each a considerable part.

There is now in London, a public institution where the art of swimming is regularly taught.

SWIME-*stone*, in mineralogy, a variety of compact luculite, a sub-species of limestone.

SWIVEL, in gunnery, a small piece of artillery carrying a shot of half a pound weight, and fixed in a socket on the top of a ship's side, stern, or bow, and also in the tops; the trunnions of this piece are contained in a sort of iron croach, the lower end of which terminates in a cylindrical pivot, resting in the socket so as to support the weight of the cannon. By means of this swivel, which gives name to the piece of artillery, and an iron handle, the gun may be directed by hand to any object.

SWORD, an offensive weapon, worn at the side, and serving either to cut or stab. Its parts are the handle, guard, and blade; to which may be added the bow, scabbard, pummel, &c.

SYLLOGISM, συλλογισμος, in logic, an argument or term of reasoning, consisting of three propositions; the two first of which are called premises, and the last the conclusion.

SYMPHONY, in music, properly denotes a consonance or concert of several sounds agreeable to the ear, whether vocal or instrumental, called also harmony.

SYNGENESIA, in botany, the name of the nineteeth class in Linnæus's system, consisting of plants in which the anthers, or male organs of generation, are united into a cylinder the filaments on which they are supported being separate and distinct: this class contains the numerous tribe of compound flowers.

SYNGNATHUS, pipefish, a genus of fishes of the order nantes: the generic character is, snout subcylindric, with terminal mouth; body lengthened, jointed, mailed; ventral fins none There are eight species.

SYNOVIA, the name given to a liquid secreted within the capsular ligaments of the joints, to facilitate motion by lubricating these parts.

SYNTAX, in grammar, the proper construction, or due disposition of the words of a language, into sentences, or phrases: or the manner of constructing one word with another, with regard to the different terminations thereof, prescribed by the rules of grammar.

SYNTHESIS, the putting of several things together, as making a compound medicine of several simple ingredients, &c.

SYRINGE, an instrument serving to imbibe, or suck in a quantity of any fluid, and to squirt or expel the same with violence.

SYRINGIA, the lilac, a genus of plants of the class of diandria and order of monogynia; and in the natural system ranging under the 44th order, sepiariæ. There are three species, the vulgaris, persica, and suspensa.

SYRINTOLE, in anatomy, the contraction of the heart, whereby the blood is drawn out of its ventricles into the arteries; the opposite state to which is called the diastole, or dilation of the heart.

SYZYGY, in astronomy, a term equally used for the conjunction and opposition of a planet with the sun.

T.

T the nineteenth letter of our alphabet. In abbreviations, amongst the Roman writers, T. stands for Titus, Titius, &c. Ti. Tiberius; Ti. F. Tiberii filius. T. L. Tiberii libertus; Ti. N. Tiberii Nepos; T. J. A. V. P. V. D. tempora judicem arbitrumve postulat ut det; T M. P. terminum posuit; T M. D D. terminum dedicavit: Tr. trans. Tribunus: Tr M. or Mil. tribunus militum; T R. P L. D E S. tribunus plebis designatus; T R. A E R. tribunus ærarii; T R V. C A P. triumviri capitales; T. R. or TRIB. POT. tribunicia; Tul. H. Tulius Hostilius.

TABASHEER. The silica which is found

in the hollow stem of the bamboo is so named. Its optical properties are peculiar. They have been described by Dr. Brewster, *Phil. Trans.* 1819.

TABBY, in commerce, a kind of rich silk, which has undergone the operation of tabbying.

TABBYING, the passing a silk or stuff through a calender, the rolls of which are made of iron or copper, variously engraven: which bearing unequally on the stuff, renders the surface unequal so as to reflect the rays of light differently, making the representation of waves thereon.

TABLE, in perspective, denotes a plane surface, supposed to be transparent, and perpendicular to the horizon. It is always imagined to be placed at a certain distance between the eye and the object, for the objects to be represented thereon by means of the visual rays passing from every point thereof through the table to the eye; whence it is called perspective-plane.

TABLE, among the jewellers, a table-diamond, or rather precious stone, is that whose upper surface is quite flat, and only the sides cut in angles; in which sense a diamond cut tablewise, is used in opposition to a rose-diamond.

TABLE, in mathematics, systems of numbers calculated to be ready at hand for the expediting astronomical, geometrical, and other operations: thus we say, tables of the stars; tables of signs, tangents, and secants; tables of logarithms, rhumbs, &c. sexagenary tables

TACHYGRAPHY, the art of writing fast, or of short hand. See STENOGRAPHY.

TACK, in a ship, a great rope having a wale-knot at one end, which is seized or fastened into the clew of the sail: so is reefed first through the chess-trees, and then is brought through a hole in the ship's side.

TACKLE, or TACKLING, among seamen, denotes all the ropes or cordage of a ship, used in managing the sails, &c.

TACTICS, in their general acceptation, relate to those evolutions, manœuvres, and positions, which constitute the main spring of military and naval finesse: they are the means whereby discipline is made to support the operations of a campaign, and are, in every regular service, studied for the purpose of training all the component parts according to one regular plan or system; whereby celerity, precision, and strength are combined, and the whole rendered completely efficient.

TÆNIA, the TAPE-WORM, in zoology, a genus of animals belonging to the class of vermes, and order of intestina. The body is long, depressed, and jointed like a chain, and contains a mouth and viscera in each joint. According to Gmelin, there are 92 species; all which inhabit the intestines of various animals, particularly of quadrupeds.

Gmelin has divided them into sections as follow: A. Those found in other parts besides the intestines, and furnished with a vesicle behind. B. Those found in the intestines only, and without a terminal vesicle. C. Those with the head unarmed with hooks. The worms of the first section are found infesting mammalia, reptiles, and fish. Those of the second section are found in the mammalia, in birds, and in fish; and those of the third section infest mammalia, birds, reptiles, and fish. This genus of worms are destined to feed on the juices of various animals, and are usually found in the alimentary canal, generally at the upper part of it. They are sometimes found in great numbers, and occasion the most distressing disorders. They have the power of reproducing parts which have been broken off, and are therefore removed with the utmost difficulty: they are oviparous, and discharge their eggs from the apertures on the joints.

TAFFETY, in commerce, a fine smooth silken stuff, remarkably glossy. See SILK. There are taffeties of all colours, some plain, and others striped with gold, silver, &c.

TALC. Of this mineral, Professor Jameson's sixth sub-species of rhomboidal mica, there are two kinds; common talc, and indurated talc.

1. *Common talc.* Colour greenish-white. Massive, disseminated in plates, imitative, and sometimes crystallized in small six-sided tables, which are druses. Splendent, pearly, semi-metallic. Cleavage single, with curved folia. Translucent. Flexible, but not elastic. Yields to the nail. Perfectly sectile. Feels very greasy. Sp. gr. 2.77. It occurs in beds in mica-slate and clay-slate. It is found in Aberdeenshire, Banffshire, and Perthshire. The finest specimens come from Saltzburg, the Tyrol, and St. Gothard. It is an ingredient in rouge for the toilette, along with carmine and benzoin. This cosmetic communicates a remarkable degree of softness to the skin, and is not injurious. The flesh polish is given to gypsum figures, by rubbing them with talc.

2. *Indurated talc*, or *talc-slate.* Colour greenish-grey. Massive. Fragments tabular. Translucent on the edges. Soft. Streak white. Rather sectile. Easily frangible. Not flexible. Feels greasy. Sp. gr. 2.7 to 2.8. It occurs in primitive mountains, where it forms beds in clay-slate and serpentine. It is found in Perthshire, Banffshire, the Shetland Islands, and abundantly on the continent. It is employed for drawing lines by carpenters, tailors, hat-makers, and glaziers.

TALENT, money of account amongst the ancients. Amongst the Jews, a talent in weight was equal to sixty maneh, or 113 ℔. 10 oz. 1 dwt. 10¾ gr.

TALES, *i. e. tales de circumstantibus*, bystanders, is used in law, for a supply of men impannelled on a jury, and not appearing, or on their appearance challenged and disallowed, when the judge upon motion orders a supply to be made by the sheriff of one or more such persons as are present in court, to make up a full jury.

TALIO, *lex talionis*, a species of punishment in the Mosaic law, whereby an evil is returned similar to that committed against us by another; hence that expression, eye for eye, tooth for tooth.

TALLOW-TREE. See CROTON.

TALLY, in law, a piece of wood cut in two parts, whereon accounts were anciently kept, by means of notches; one part of the tally being kept by the debtor, and the other by the creditor.

TALMUD, or THALMUD, among the Jews, a collection of the doctrines of their religion or morality. It is the corpus juris, or body of the laws and customs of the Jews, who esteem it equal to the scriptures themselves.

TALPA, MOLE, a genus of the quadrupeds of the order feræ. The generic character is, front teeth in the upper jaw six, unequal; in the lower jaw eight; canine teeth, one on each side, the upper ones largest; grinders seven in the upper jaw, six in the lower.

1. *Talpa Europæa*, the common mole. The whole form of the mole is eminently calculated by nature for its obscure and subterraneous life. The body is thick and cylindric; the snout slender, but very strong and tendinous; the head not distinguished from the body by any appearance of neck; the legs so extremely short as scarcely to project perceptibly from the body; the skin is much thicker and tougher in proportion than in other quadrupeds, and the fur with which it is covered equally surpasses that of other animals in fineness and softness. The muscular strength of the mole is very great, and it is enabled to force itself into the ground with an extraordinary degree of celerity. The general length of the mole is about five inches and three quarters, exclusive of the tail, which measures one inch.

2. *Talpa radiata*, radiated mole. This is somewhat smaller than the common mole, and is of a dusky or blackish colour. In general form, it resembles the preceding species, having broad fore legs with long claws; the hind legs scaly and with much weaker claws; the nose long, and beset at the end with a circular series of radiated tendrils; the length from nose to tail is three inches and three quarrers. It is an inhabitant of North America.

TAMARINDUS, the *tamarind-tree*, a genus of plants arranged by Linnæus under the class of triandria and order of monogynia; but Woodville, Schreber, and other late botanists, have found that it belongs to the class of monadelphia, and order of triandria. In the natural system it is ranged under the lomantaceæ. There is only one species, Indica, which is a native of both Indies, of America, of Arabia, and of Egypt. The timber of the tamarind tree is heavy, firm, and hard; sawn into boards, it is converted to many useful purposes in building. The fruit is used both in food and medicine. In many parts of America, particularly in Curacao, they eat abundance of it raw, without any inconvenience. In Martinico also, they eat the unripe fruit, even of the most austere kind.

TANNIN. This, which is one of the immediate principles of vegetables, was first distinguished by Seguin from the gallic acid, with which it had been confounded under the name of the *astringent principle.* He gave it the name of tannin, from its use in the tanning of leather; which it effects by its characteristic property, that of forming with gelatin a tough insoluble matter.

It may be obtained from vegetables by macerating them in cold water; and precipitated from this solution, which contains likewise gallic acid and extractive matter, by hyperoxygenized muriate of tin.

TANNING. The several kinds of leather are prepared from the skins of animals macerated with lime and water, to promote the separation of the hair and wool, and of the fat and fleshy parts, in which recourse is also had to the assistance of mechanical pressure, scraping, and the like. The skin, when thus deprived of its more putrescible part, and brought considerably toward the state of mere fibre, is tanned by maceration with certain astringent substances, particularly the bark of the oak-tree

The hide consists almost wholly of gelatin and all that is necessary is, to divest it of the hair, epidermis, and any flesh or fat adhering to it. This is commonly done, after they have been soaked in water some time, and handled or trodden to cleanse them from filth, by immersing them in milk of lime. Some, instead of lime, use an acescent infusion of barley or rye-meal, or spent tan; and others recommend water acidulated with sulphuric acid. Similar acidulous waters are afterward employed for raising or swelling the hide, when this is necessary.

The skins, thus prepared, are finally to undergo what is properly called the tanning. This is usually done by throwing into a pit, or cistern made in the ground, a quantity of ground oak-bark, that has already been used, and on this the skins and fresh bark in alternate layers, covering the whole with half a foot of tan, and treading it well down. The tanning may be accelerated by adding a little water.

TANTALITE, in mineralogy, a metallic fossil of an iron black colour on the external surface, but internally between bluish-grey, and iron-black. It occurs imbedded, in masses of the size of a hazel nut, which have a tendency to the octahedral form.

TANTALIUM, a metal discovered by M. Ekeberg, in the mineral just mentioned; and in another named Ytrotantalite.

TANTALUS, or IBIS, a genus of birds of the order grallæ. The generic character is, bill long, subulate, roundish subarched; face naked; nostrils oval; feet four-toed, palmate at the base. There are 19 species.

TANTALUS'S CUP. See HYDRAULICS.

TAPE-*worm.* See TÆNIA.

TAPESTRY, a kind of woven hangings of wool and silk, frequently raised and enriched with gold and silver, representing figures of men, animals, landscapes, histories, &c.

TAPIR, a genus of quadrupeds of the order belluæ. The generic character is, front teeth in both jaws, ten; canine teeth in both jaws, single, incurvated: grinders in both jaws, five on each side, very broad; feet with three hoofs, and a false hoof on the fore feet.

TAR, a thick, black, unctuous substance, obtained from old pines and fir trees, by burning them with a close smothering heat: it is used for coating and caulking ships, &c. and various other purposes.

TARANTULA. See ARANEA.

TARE, is an allowance for the outside package, that contains such goods as cannot be unpacked without detriment, or for the papers, threads, bands, &c. that inclose or bind any goods imported loose; or, though imported in casks, chests, &c. yet cannot be unpacked and weighed net.

TARGUM, a name whereby the Jews call the Chaldee paraphrases, or expositions of the Old Testament, in the Chaldee language.

TARIF, or TARIFF, a table or catalogue, containing the names of different sorts of merchandize, with the duties to be paid, as settled by authority, amongst trading nations.

TARRAS, or TERRAS, a volcanic earth

used as a cement. It does not differ much in its principles from pouzzolana; but it is much more compact, hard, porous, and spongy. It is generally of a whitish-yellow colour, and contains more heterogeneous particles, as spar, quartz, schorl, &c. and something more of a calcareous earth. It effervesces with acids, is magnetic, and fusible *per se*. When pulverized, it serves as a cement, like pouzzolana. It is found in Germany and Sweden. See LIME.

TARTAR is deposited on the sides of casks during the fermentation of wine; it forms a lining more or less thick, which is scraped off. This is called crude tartar, and is sold in Languedoc from 10 to 15 livres the quintal.

Tartar is distinguished from its colour into red and white: the first is afforded by red wine.

Tartar is purified from an abundant extractive principle, by processes which are executed at Montpellier and at Venice.

The following is the process used at Montpellier:—The tartar is dissolved in water, and suffered to crystallize by cooling. The crystals are then boiled in another vessel, with the addition of five or six pounds of the white argillaceous earth of Murviel to each quintal of the salt. After this boiling with the earth, a very white salt is obtained by evaporation, which is known by the name of cream of tartar, or the acidulous tartrate of potash.

TARTARIC ACID. The casks in which some kinds of wine are kept become incrusted with a hard substance, tinged with the colouring matter of the wine, and otherwise impure, which has long been known by the name of *argal*, or tartar, and distinguished into red and white according to its colour. This being purified by solution, filtration, and crystallization, was termed *cream*, or *crystals of tartar*. It was afterwards discovered, that it consisted of a peculiar acid combined with potash; and the supposition that it was formed during the fermentation of the wine, was disproved by Boerhaave, Neuman, and others, who showed that it existed ready formed in the juice of the grape. It has likewise been found in other fruits, particularly before they are too ripe; and in the tamarind, sumac, balm, carduus benedictus, and the roots of rest-harrow, germander, and sage. The separation of tartaric acid from this acidulous salt, is the first discovery of Scheele that is known. He saturated the superfluous acid, by adding chalk to a solution of the super-tartrate in boiling water as long as any effervescence ensued, and expelled the acid from the precipitated tartrate of lime by means of the sulphuric. Or four parts of tartar may be boiled in twenty or twenty-four of water, and one part of sulphuric acid added gradually. By continuing the boiling, the sulphate of potash will fall down. When the liquor is reduced to one-half, it is to be filtered; and if any more sulphate be deposited by continuing the boiling, the filtering must be repeated. When no more is thrown down, the liquor is to be evaporated to the consistence of a syrup; and thus crystals of tartaric acid, equal to half the weight of the tartar employed, will be obtained.

TARTRATS, salts formed with the tartaric acid.

TAURUS. See ASTRONOMY.

TAX. See REVENUE, CUSTOMS, &c.

TAXUS, the YEW-TREE, a genus of plants of the class of diœcia, and order of monadelphia; and in the natural system ranging under the 51st order, coniferæ. There are four species; of which the baccata, or common yew-tree, is a native of Britain, France, Switzerland, &c. and of North America. It is distinguished from the other species by linear leaves which grow very close, and by the receptacles of the male flowers being subglobose. The wood is reddish, full of veins, and flexible, very hard and smooth, and almost incorruptible. Its hardness renders it very proper for turners and cabinet-makers.

TEARS, a name for the limpid fluid secreted by the lachrymal glands, and flowing on the surface of the eye; either in consequence of local irritation, or the emotions of grief.

The tears have no smell, but a saltish taste. The uses of the tears are these: 1. They continually moisten the surface of the eye and eyelids, to prevent the transparent cornea from drying and becoming opaque, or the eye from concreting with the eye-lids. 2. They prevent that pain which would otherwise arise from the friction of the eye-lids against the ball of the eye from continually winking. 3. They wash away dust, or any thing acrid, that may have fallen into the eye.

TEETH. The basis of the substance that forms the teeth, like that of other bones, (see BONE,) appears to be phosphate of lime. The enamel, however, according to Mr. Hatchett, differs from other bony substances in being destitute of cartilage: for raspings of enamel, when macerated in diluted acids, he found were wholly dissolved; while raspings of bone, treated in the same manner, always left a cartilaginous substance untouched.

TELEGRAPH, an instrument by means of which information may be quickly conveyed to a considerable distance. The telegraph is by no means a modern invention. There is reason to believe that amongst the Greeks there was some sort of telegraph in use. A Greek play begins with a scene, in which a watchman descends from the top of a tower in Greece, and gives the information that Troy was taken. "I have been looking out these ten years (says he) to see when that would happen, and this night it is done."

The telegraph however was not brought into general use till the French revolution.

TELESCOPE. See OPTICS.

TELLURIUM. See CHEMISTRY.

TEMPERAMENT, in music, the accommodation or adjustment of the imperfect sounds by transferring a part of their defects to the more perfect ones, in order to remedy, in some degree, the false intervals of those instruments, the sounds of which are fixed; as the organ, harpsichord, piano-forte, &c.

TEMPERATURE. See METEOROLOGY.

TEMPERING *of steel and iron*, the rendering of them either more compact and hard, or soft and pliant, according as the different uses for which they are wanted may require.

TEMPLARS, or TEMPLERS, a religious order instituted at Jerusalem, about the year 1118. Some religious gentlemen put themselves under the government of the patriarch of Jerusalem, renounced property, made the vow of celibacy and obedience, and lived like canons regular. King Baldwin assigned them an apartment in his palace.

TENACITY. See COHESION.

TENAILLE, in fortification, a kind of outwork, resembling a hornwork, but generally somewhat different; for, instead of two demi-bastions, it bears only in front a re-entering angle between the same wings without flanks; and the sides are parallel.

TENANT, signifies one who holds or possesses lands or tenements by any kind of right, either in fee, for life, years, or at will.

TENCH. See CYPRINUS.

TENDER, in law, is an offer to pay a debt, perform a duty. This is often pleaded in action as a bar to the plaintiff's recovery; and where the money demanded by the plaintiff has been tendered or offered to him before the commencement of the suit, and he has refused to accept it, the plaintiff is barred of his action and costs.

TENDER, a small ship in the service of men of war, for carrying of men, provisions, or any thing else that is necessary.

TENDONS, are white, firm, and tenacious parts, continuous to the muscles, and usually forming their extremities.

TENEMENT, in its common acceptation, is applied only to houses and other buildings; but in its original, proper, and legal sense, it signifies every thing that may be holden, provided it be of a permanent nature, whether it be of a substantial or of an unsubstantial and ideal kind.

TENNIS, a play at which a ball is driven by a racket; this play is much in use in most of the capital cities of Europe.

TENON, in building, &c. the square end of a piece of wood, or metal, diminished by one-third of its thickness, to be received into a hole in another place, called a mortise, for jointing or fastening the two together. It is made in various forms, square, dove-tailed, for double mortises, &c.

TENOR, of writs, records, &c. is the substance or purport of them, or a transcript or copy.

TENOR, in music, the second of the four parts in harmonical composition, reckoning from the bass. The tenor is the part most accommodated to the common voice of man; from which circumstance it has sometimes, by way of preference, been called "the human voice." Its general compass extends from C above G gamut to G the treble-cliff note.

TENOR-*cliff*, the name given to the C cliff, when placed on the fourth line of the stave.

TENOR VIOLIN, or *Viola*, a stringed instrument resembling the violin, but lower in its scale, having its lowest note in C above G gamut. In concert this instrument takes the part next above the bass.

TENSE, *time*, in grammar, an inflection of verbs, whereby they are made to signify or distinguish the circumstance of time, in what they affirm.

TENSION, the state of a thing stretched. Thus animals sustain and move themselves by the tension of their muscles and nerves. A chord or string gives an acuter or deeper sound, as it is in a greater or less degree of tension, that is, more or less stretched or tightened.

TENTER, a railing used in the cloth-manufacture, to stretch out the pieces of cloth, stuff, &c. or only to make them even, and set them square. It is usually about four feet and a half high, and for length exceeds that of the longest piece of cloth.

TENURE, the manner whereby lands or tenements are holden, or the service that the tenant owes to his lord.

TEREBELLA, a genus of vermes mollusca. The generic character is, body oblong, creeping, naked, often enclosed in a tube furnished with lateral tufts and branchiæ; mouth placed before, furnished with lips, without teeth, and protending a clavate proboscis; feelers numerous, ciliate, capillary, seated round the mouth.

TEREDO, in natural history, a genus of vermes belonging to the order of testacea. The animal is a terebella; there are two valves, calcareous, hemispherical, and cut off before and two lanceolated. The shell is tapering, bending, and capable of penetrating wood.

TERM, in geometry, is the extreme of any magnitude, or that which bounds and limits its extent.

TERMS, of an equation, or of any quantity, in algebra, are the several numbers of which it is composed separated from one another by the signs + or −. So, the quantity $ax + 2bc - 3ax^2$, consists of the three terms ax and $2bc$ and $3ax^2$.

TERMS, are those spaces of time wherein the courts of justice are open for all that complain of wrongs or injuries, and seek their rights by course of law or action in order to their redress; and during which, the courts in Westminster Hall sit and give judgments, &c. but the high court of parliament, the chancery and inferior courts, do not observe the terms; only the courts of king's bench, common-pleas, and exchequer, the highest courts at common law. Of these terms there are four in every year, viz. Hilary term, which begins the 23d of January, and ends the 12th of February, unless on Sundays, and the day after; Easter term, which begins the Wednesday fortnight after Easter-day, and ends the Monday next after ascension day; Trinity term, which begins the Friday after Trinity Sunday, and ends the Wednesday fortnight after; and Michaelmas term begins the 6th and ends the 28th of November.

TERMS, *Irish*, are the same as those in London, except that at Michaelmas, which commences October 13, and adjourns to the beginning of November.

TERMS, *Cambridge*. Lent term begins on Jan. 13. and ends the Friday before Palm Sunday. Easter term begins the Wednesday after Easter week, and ends the week before Whit-Sunday. Trinity term begins the Wednesday after Trinity Sunday, and ends the Friday after the commencement. Michaelmas term begins Oct. 10, and ends Dec. 16.

TERMS, *Oxford*. Hilary, or Lent term, begins on Jan. 14, and ends the Saturday before Palm Sunday. Easter term begins the tenth day after Easter, and ends the Thursday before Whit-Sunday. Trinity term begins the Wednesday after Trinity Sunday, and ends after the act, sooner or later, as the vice-chancellor and convocation please. Michaelmas term begins on Oct. 10, and ends Dec. 17.

TERMS, *Scottish*. In Scotland, Candlemas term begins Jan. 23, and ends Feb. 12. Whitsuntide term begins May 25, and ends June 15 Lammas term begins July 30, and ends Aug. 8.

Martinmas terms begins Nov. 3, and ends Nov. 29.

TERMES, *the white ant*, a genus of insects of the order aptera: the generic character is, legs six, formed for running; eyes two; antennæ setaceous; mouth furnished with two jaws. There are ten species, in two sections: A. antennæ moniliform; B. antennæ setaceous.

T. *fatale*, or white ant, is brown above; thorax with three segments; wings pale with a testaceous rib. A most curious account of this insect is given in the Philosophical Transactions, of which we shall notice a few particulars. The animals of this extraordinary community, far exceeding in wisdom and policy the bee, the ant, or beaver, are inhabitants of East India, Africa, and South America. They build pyramidal structures ten or twelve feet in height, and divided into appropriate apartments, magazines for provisions, arched chambers, and galleries of communication. These are so firmly cemented that they easily bear four men to stand upon them, and in the plains of Senegal appear like the villages of the natives. With such wonderful dexterity and rapidity they destroy food, furniture, books, clothes, and timber of whatever magnitude, leaving a mere thin surface; that in a few hours a large beam will be eaten to a mere shell not thicker than writing paper. Larva small, about a quarter of an inch long: six-footed, pale with a roundish testaceous head; eyes none; mandibles short, strong, and toothed; antennæ as long as the thorax, and ovate abdomen. These only are the labourers, who build the structures, procure provisions for the males and females, and take care of the eggs: they are the most numerous. Pupa larger, about half an inch long, with a very large ovate polished testaceous head; eyes none; mandibles projecting, as long as the head, forked, without teeth, sharp and black; thorax and abdomen palish. These never work, but act as superintendants over the labourers, or as guards to defend their habitations from intrusion and violence. When a breach is made in the dwelling, they rush forward, and defend the entrance with great ferocity; some of them beating with their mandibles against any hard substance, as a signal to the other guards, or as encouragement to the labourers; they then retire, and are succeeded by the labourers, each with a burthen of tempered mortar in his mouth, and who diligently set about to repair whatever injury has been sustained. One of these attends every six or eight hundred labourers, who are building a wall, taking no active part himself, but frequently making the noise above mentioned, which is constantly answered by a loud hiss from all the labourers, who at this signal evidently redouble their diligence.

TERMINATOR, in astronomy, a name sometimes given to the circle of illumination, from its property of terminating the boundaries of light and darkness. This line will, of course, pass through the poles of the earth at the equinoxes.

TERRIER, a book or roll, wherein the several lands, either of a private person, or of a town, college, church, &c. are described.

TESSELLATED PAVEMENTS, those of rich mosaic work, made of curious squares marbles, bricks, or tiles, called *tesselæ*, from their resembling dice.

TEST, a vessel used in metallurgy for absorbing the scoriæ of metallic bodies when melted.

* **TEST-ACT.** A statute 25 Car. II, cap. 2. which requires all officers, both civil and military, to take the oaths and test, viz. the sacrament, according to the rites and ceremonies of the church of England. Various ineffectual attempts have been made by the dissenters to obtain the repeal of this act, which is evidently offensive to the genuine principles of civil and religious liberty. Its natural and unavoidable tendency is to increase the number of hypocrites in the country; and to keep conscientious men out of those situations in which they are so much wanted.

TESTACEA, in the Linnæan system of natural history, the third order of vermes. This order comprehends all shell-fish, arranged by Linnæus under thirty-six genera. Shell-fish are animals with a soft body, covered by or inclosed in a firm, hard, and stony habitation, composed according to their three separate orders.

TESTAMENT, in law, a solemn and authentic act, whereby a person declares his will, as to the disposal of his estates, effects, burial, &c. See WILL.

TESTUDO, the *tortoise*, in natural history, a genus of amphibia of the order reptiles. Generic character: body tailed, covered above and beneath, defended by a bony covering, covered by a horny, scaly, or coriaceous integument; a bony mouth, without distinct teeth, and the upper mandible closing over the lower. These animals feed on sea-weeds or on worms, are extremely prolific; but in the state of eggs, and while very young, are the prey of various animals. Their movements are slow, they are capable of being tamed, and will in that state eat almost any thing presented to them. They exist long in such air as would be destructive to other animals of the same size, and have such tenaciousness of life, that it is stated they will exhibit convulsive movements for several days after their bodies have been opened, and even after their heads have been cut off. In cold latitudes the land tortoise is torpid during the winter. There are thirty-five species, of which the principal is, the testudo græca, or the common tortoise. The weight of this animal is three pounds, and the length of its shell about seven inches. It abounds in the countries surrounding the Mediterranean, and particularly in Greece, where the inhabitants not only eat its flesh and eggs, but frequently swallow its warm blood. In September or October it conceals itself, remaining torpid till February, when it re-appears. In June it lays its eggs, in holes exposed to the full beams of the sun, by which they are matured. The males will frequently engage in severe conflicts, and strike their heads against each other with great violence, and very loud sounds. Tortoises attain most extraordinary longevity, and one was ascertained to have lived in the gardens of Lambeth to the age of nearly 120 years. Its shell is preserved in the archiepiscopal palace. So reluctant is the vital principle to quit these animals, that Shaw informs us, from Redi, one

of them lived for six months after all its brain was taken out, moving its limbs, and walking as before.

TESTUDO, in the military art of the ancients, was a kind of cover or screen which the soldiers, *e. gr.* a whole company made themselves of their bucklers, by holding them up over their heads, and standing close to each other. This expedient served to shelter them from darts, stones, &c. thrown upon them, especially those thrown from above, when they went to the assault.

TESTUDO was also a kind of large wooden tower which moved on several wheels, and was covered with bullocks' hides, serving to shelter the soldiers when they approached the walls to mine them, or to batter them with rams.

TETRACHORD, in the ancient music, a concord consisting of four degrees or intervals, and four terms or sounds; called also by the ancients diatessarron, and by us a fourth.

TETRADYNAMIA (τεσσαρες, *four*, and δυναμις, *power*,) four powers; the name of the 15th class in Linnæus's sexual system.

TETRAGYNIA (τεσσαρες, *four*, and γυνη, a *woman*,) the name of an order, or secondary division, in the 4th, 5th, 6th, 8th, and 13th classes in the sexual system.

TETRANDRIA (τεσσαρες, *four*, and ανηρ, a *man* or *husband*,) the name of the fourth class in Linnæus's sexual system.

TETRAO, in ornithology, a genus of birds belonging to the order of gallinæ, and thus characterised by Linnæus: there is a spot near the eyes naked or papillose, or covered, though more rarely, with feathers. There are venty-three species, of which the following are best deserving of notice:

T. *urogallus*, or the cock of the wood, is of the size of a turkey, and is found from Russia to Italy, preferring the elevated and mountainous parts of temperate countries, as it delights in a cold temperature. Its eggs are deposited on moss, and whenever left by the female, who is unassisted in the process of incubation, are covered over with leaves. The males and females live separate, except during the months of February and March. Their food consists of various plants and grains, and of buds of trees. The seeds of the pine and fir they are particularly fond of.

T. *tetrix*, or the black grouse, is larger than a common fowl, and abounds in the British islands, particularly in the northern districts. The birds of this species, and of the last, do not pair like other birds, and the male is generally seen with several females in his train. They subsist on seeds and herbage, and are particularly fond of the seeds of the birch and Siberian poplar.

T. *lagopus*, or the ptarmigan grouse, is fourteen inches long, and inhabits the north of Europe. It is not uncommon in the Orknies and the Hebrides, and is sometimes found in Cumberland. These birds subsist on seeds, fruits, and berries, and are like the last, silly and inadvertent to danger.

T. *perdrix*, the common partridge, is about nineteen inches long, and is principally found in the temperate regions of Europe; in England it is a favourite delicacy at the tables of the rich. The manners of the partridge much resemble those of poultry in general.

T. *coturnix*, or the quail, is between seven and eight inches long, and inhabits almost every country of the old world, but is not found in America. It is migratory, and moves in spring towards the colder climates, returning southerly in autumn. In these progresses quails fly in immense multitudes, and are taken in the islands of the Archipelago in such numbers as for a short time to be the principal article of food for the inhabitants, and to constitute an important source of income and revenue. Within a few miles, along the coasts of Italy, a hundred thousand are said to have been taken in a single day.

TEUTONIC ORDER, a military order of knights, established towards the close of the twelfth century, and thus called as consisting chiefly of Germans or Teutons. The origin, &c. of the Teutonic order is said to be this: The Christians, under Guy of Lusignan, laying siege to Acre, a city of Syria, on the borders of the Holy Land, some Germans of Bremen and Lubec, touched with compassion for the sick and wounded of the army, who wanted common necessaries, set on foot a kind of hospital under a tent, which they made of a ship's sail, and here betook themselves to a charitable attendance on them. This excited a thought of establishing a third military order, in imitation of the templars and hospitalers. The design was approved of by the patriarch of Jerusalem, the archbishops and bishops of the neighbouring places, the king of Jerusalem, the masters of the temple and hospital, and the German lords and prelates then in the Holy Land, and pope Calixtus III. confirmed it by his bull, and the new order was called the order of Teutonic knights of the house of St. Mary at Jerusalem.

TEXT, a relative term, contradistinguished to gloss or commentary, and signifying an original discourse exclusive of any note or interpretation. This word is particularly used for a certain passage of scripture, chosen by a preacher to be the subject of his sermon.

THALLITE, a stone found in the fissures of mountains in Dauphiny, and on Chamouni, in the Alps. It is sometimes amorphous, and sometimes crystallized. The primitive form of its crystals is a rectangular prism, whose bases are rhombs with angles of 114 deg. 37 min. and 65 deg. 23 min. The most usual variety is an elongated four-sided prism, (often flattened) terminated by four-sided incomplete pyramids; sometimes it occurs in regular six-sided prisms. The crystals are often very slender. Its texture appears fibrous. Lustre 2. Glassy. Causes single refraction. Brittle. Specific gravity 3.45 to 3.46. Colour dark green. Powder white or yellowish green, and feels dry. It does not become electric by heat. Before the blowpipe, froths, and melts into a black slag. With borax melts into a green bead.

THEA, the *tea-tree*, in botany, a genus of the class and order polyandria monogynia. The corolla is six or nine-petalled; the calyx five or six-leaved; the capsule tricoccous. There are two species, or at least principal varieties; the viridis or green, and the bohea, which again admit of various subdivisions or varieties.

The tea plant is a native of Japan, China, and Tonquin, and has not been found growing spontaneously in any other part of the world. This plant delights in valleys, and is frequent on the sloping sides of mountains and the

banks of rivers, where it enjoys a southern exposure. It flourishes in the northern latitudes of Pekin as well as round Canton; but attains the greatest perfection in the mild temperate regions of Nankin. In this country teas are generally divided into three kinds of green, and five of bohea: the former are, 1. Imperial, or bloom tea, with a large loose leaf, light green colour, and a faint delicate smell. 2. Hyson, so called from the name of the merchant who first imported it; the leaves of which are closely curled and small, of a green colour, verging to a blue. 3. Singlo tea, from the name of the place where it is cultivated. The boheas are, 1. Souchong, which imparts a yellow-green colour by infusion. 2. Camho, so called from the place where it is made; a fragrant tea, with a violet smell; its infusion pale. 3. Congo, which has a larger leaf than the preceding, and ts infusion somewhat deeper, resembling common bohea in the colour of the leaf. 4. Pekoe

white flowers mixed with it. 5. Common bohea, whose leaves are of one colour. There are other varieties, particularly a kind of green tea, done up in roundish balls, called gunpowder tea.

THEFT, in law, an unlawful felonious taking away another man's moveable and personal goods against the owner's will, with intent to steal them. It is divided into theft or larceny, properly so called, and petit theft, or petit larceny; the former whereof is of goods above the value of 12*d.* and is deemed felony; the other, which is of goods under that value, is not felony.

THEODOLITE, a mathematical instrument much used in surveying, for the taking of angles, distances, &c.

THEOREM, a proposition which terminates in theory, and which considers the properties of things already made or done. Or a theorem is a speculative proposition, deduced from several definitions compared together.

THERMOMETER. An instrument for measuring heat, founded on the principle, that the expansions of matter are proportional to the augmentations of temperature. A common thermometer, therefore, is merely a vessel in which very minute expansions of mercury may be rendered perceptible; and, by certain rules of graduation, be compared with expansions made on the same liquid, by other observers.

Air is the most expansible fluid, but it does not receive nor part with its heat so quickly as mercury. Alcohol does not expand much by heat. In its ordinary state it does not bear a much greater heat than 175° of Fahrenheit; but when highly rectified it can bear a greater degree of cold than any other liquor hitherto employed as a measure of temperature. At Hudson's Bay, Mr. Macnab, by a mixture of vitriolic acid and snow, made it to descend to 69° below 0 of Fahrenheit. There is an inconvenience, however, attending the use of this liquor; it is not possible to get it always of the same degree of strength. As to oil, its expansion is about 15 times greater than that of alcohol; it sustains a heat of 600°, and its freezing point is so low that it has not been determined; but its viscosity renders it useless.

Mercury is far superior to alcohol and oil, and is much more manageable than air. 1. As far as the experiments already made can determine, it is of all the fluids hitherto employed in the construction of thermometers, that which measures most exactly equal differences of heat by equal differences of its bulk: its dilatations are, in fact, very nearly proportional to the augmentations of heat applied to it. 2. Of all liquids it is the most easily freed from air. 3. It is fitted to measure high degrees of heat and cold. It sustains a heat of 600° of Fahrenheit's scale, and does not congeal till it fall 39 or 40 degrees below 0. 4. It is the most sensible of any fluid to heat and cold, even air not excepted. Count Rumford found, that mercury was heated from the freezing to the boiling point in 58 seconds, while water took 2 minutes 13 seconds, and common air 10 minutes and 17 seconds. 5. Mercury is a homogeneous fluid, and every portion of it is equally dilated or contracted by equal variations of heat. Any one thermometer, made of pure mercury, is *cæteris paribus*, possessed of the same properties with every other thermo-

of pure mercury. Its pov

expansion is indeed about six times less than that of spirit of wine, but it is great enough to answer most of the purposes for which a thermometer is wanted. The fixed points, which are now universally chosen for adjusting thermometers to a scale, and to one another, are the boiling and freezing water points. In order to ensure uniformity, therefore, in the construction of thermometers, it is now agreed, that the bulb of the tube be plunged in the water when it boils violently, the barometer standing at 30 English inches, and the temperature of the atmosphere 55 degrees.

As artists may be often obliged to adjust thermometers under very different pressures of the atmosphere, philosophers have been at pains to discover a general rule which might be applied on all occasions.

1. To convert the degrees of Reaumur into those of Fahrenheit; $\frac{R\times9}{4}+32=F$.

2. To convert the degrees of Fahrenheit into those of Reaumur; $\frac{(F-32)\times4}{9}=R$.

To such readers as are unacquainted with the algebraic expression of arithmetical formulæ, it will be sufficient to express one or two of these in words to explain their use: 1. Multiply the degree of Reaumur by 9, divide the product by 4, and to the quotient add 32, the sum expresses the degree of the scale of Fahrenheit. 2. From the degree of Fahrenheit subtract 32, multiply the remainder by 4, and divide the product by nine, the quotient is the degree according to the scale of Reaumur, &c.

Thermometers have been made of a great variety of shapes and sizes.

The most common form is represented by Fig. 3, plate XXXIV. This figure shows merely the tube and index-plate; these are fitted up in cases of various kinds, according to the purpose for which they are wanted.

The common contrivance for a self-registering thermometer, now sold in most of the London shops, consists simply of two thermometers, one mercurial, and the other of alcohol, Fig. 4. having their stems horizontal; the former has for its index a small bit of magnetical steel wire, and the latter a minute thread of glass, having its two ends formed into small knobs, by fusion in the flame of a candle.

The magnetical bit of wire lies in the vacant space of the mercurial thermometer, and is pushed forward by the mercury whenever the temperature rises, and pushes that fluid against it; but when the temperature falls, and the fluid retires, this index is left behind, and consequently shows the maximum. The other index, or bit of glass, lies in the tube of the spirit thermometer immersed in the alcohol; and when the spirit retires, by depression of temperature, the index is carried along with it, in apparent contact with its interior surface; but, on increase of temperature, the spirit goes forward and leaves the index, which therefore shows the minimum of temperature since it was set. As these indexes merely lie in the tubes, their resistance to motion is altogether inconsiderable. The steel index is brought to the mercury by applying a magnet on the outside of the tube, and the other is duly placed at the end of the column of alcohol, by inclining the whole instrument.

THORACIC, a term applied to an order of fishes in the Linnæan system; the character of this order of fishes is, that they have bony gills, and ventral fins placed directly under the thorax.

THRASHING or *Threshing*, in agriculture, the art of beating the corn out of the ears.

THRAVE, or *Threave of corn*, twenty-four sheaves, or four shocks of six sheaves to the shock, though in some counties, they only reckon twelve shocks to the thrave.

THREAD, a small line made up of a number of fine fibres of any vegetable or animal substance, such as flax, cotton, or silk; from which it takes its name of linen, cotton, or silk thread.

THREATENING LETTER. See LETTERS.

THRUSH. See TURDUS.

THUMERSTONE. See MINERALOGY.

THUNDER, the noise occasioned by the explosion of a flash of lightning passing through the air: or it is that noise which is excited by a sudden explosion of electrical clouds, which are therefore called thunder clouds.

The rattling in the noise of thunder, which makes it seem as if it passed through arches, is probably owing to the sound being excited among clouds hanging over one another, and the agitated air passing irregularly between them.

THYMUS, THYME, a genus of plants of the class didynamia, and order gymnospermia; and in the natural system ranging under the 42d order, verticillatæ. The calyx is bilabiate, and its throat closed with soft hairs. There are 22 species; of which only two are natives of Britain, the serpyllum and acinos.

TIDES. See ASTRONOMY.

TIERCE, or TERCE, a measure of liquid things, as wine, oil, &c. containing the third part of a pipe, or forty-two gallons. See MEASURE.

TIGER. See FELIS.

TIGERSHELL, a beautiful species of voluta, of a dusky-red colour, spotted all over with large irregular blotches of white: it is brought from the East Indies, and is about two inches and a half in length, and about an inch in diameter.

TILE, in building, a sort of thin brick, used on the roofs of houses; or more properly a kind of clayey earth, kneaded and moulded of a just thickness, dried and burned in a kiln, like a brick and used in the covering and paving of different kinds of military and other buildings.

TILLER *of a ship* a strong piece of wood fastened in the head of the rudder, and in smal ships and boats called the helm.

TIMBER, includes all kinds of felled and seasoned woods. Of all the different kinds known in Europe, oak is the best for building and even when it lies exposed to air and water, there is none equal to it. Fir-timber is however perhaps more generally useful than any other. It is used for flooring, wainscoting, and the ornamental parts of building within doors. Elm is the next in use, especially in England and France; it is very tough and pliable, and therefore easily worked; it does not readily split, and it bears driving of bolts and nails better than any other wood. Ash is chiefly used by wheelrights, and coachmakers, for shafts, naves, &c. Beech is also used for many purposes; it is very tough and white when young, and of great strength, but liable to warp very much when exposed to the weather, and to be worm-eaten when used within doors; its greatest use is for planks, bedsteads, chairs, and other household goods.

The goodness of timber not only depends on the soil and situation on which it stands, but likewise on the season wherein it is felled. In this, people disagree very much; some are for having it felled as soon as its fruit is ripe, others in the spring, and many in the autumn. But as the sap and moisture of timber is certainly the cause that it perishes much sooner than it otherwise would do, it seems evident that timber should be felled when there is the least sap in it, viz. from the time that the leaves begin to fall, till the trees begin to bud. This work usually commences about the end of April in England, because the bark then rises most freely; for where a quantity of timber is to be felled, the statute requires it to be done then, for the advantage of tanning.

After timber has been felled and sawed, it must be seasoned; for which purpose some advise it to be laid up in a very dry airy place, yet out of the wind and sun, or at least free from the extremities of either; and that it may not decay, but dry evenly, they recommend it to be daubed over with cow-dung. It must not stand upright, but lie all along, one piece over another; only kept apart by short blocks, interposed to prevent a certain mouldiness, which they otherwise are apt to contract in sweating on one another; from which arises frequently a kind of fungus, especially if there be any sappy parts remaining. Others advise the planks of timber to be laid for a few days in some pool or running stream, in order to extract the sap, and afterwards to dry them in the sun or air. By this means, it is said, they will be prevented from either chopping, casting, or cleaving, but against shrinking there is no remedy.

TIMBER-TREES, in law, are properly oak, ash, and elm. In some particular countries, by local custom, other trees, being commonly there made use of for building, are considered as timber. Of these, being part of the freehold, larceny cannot be committed; but, if they be severed at one time, and carried away at another, then the stealing of them is larceny

And by several late statutes, the stealing of them in the first instance is made felony, or incurs a pecuniary forfeiture. For the better preservation of roots, shrubs, and plants, it is enacted by 6 George III. c. 48, that every person convicted of damaging, destroying, or carrying away any timber-tree, or trees, or trees likely to become timber, without consent of the owner, &c. shall forfeit for the first offence not exceeding £20, with the charges attending; and on non-payment shall be committed for not more than twelve, nor less than six months; for the second offence, a sum not exceeding £30, and on non-payment shall be committed for not more than eighteen, and not less than twelve months; and for the third offence, is to be transported for seven years. All oak, beech, chesnut, walnut, ash, elm, cedar, fir, asp, lime, sycamore, and birch-trees, shall be deemed and taken to be timber trees, within the true meaning and provision of this act.

TIME, a succession of phenomena in the universe; or a mode of duration, marked by certain periods or measures, chiefly by the motion and revolution of the sun. The idea of time, in general, Mr. Locke observes, we acquire by considering any part of infinite duration as set out by periodical measures: the idea of any particular time, or length of duration, as a day, an hour, &c. we acquire first, by observing certain appearances at regular, and, seemingly, at equidistant periods.

Time, *astronomical*, is that taken purely from the motion of the heavenly bodies, without any other regard.

Time, *civil*, is the former time accommodated to civil uses, and formed and distinguished into years, months, days, &c.

Time, in music, is an affection of sound, whereby we denominate it long or short, with regard to its continuance in the same degree of time.

TIN. See Chemistry.

TINNING. Tin combines with iron, and adheres strongly to its surface, forming a thin covering. This is one of the most useful combinations of tin, for it renders the iron fit for a great many valuable purposes, for which, otherwise, on account of its strong tendency to oxidation, or rusting, it would be totally inapplicable. This is well known by the name of tin-plate, or white iron. The process of tinning iron is the following: the plates of iron being reduced to the proper thickness, are cleaned by means of a weak acid. For this purpose the surface is first cleaned with sand, to remove any rust that may have formed. They are then immersed in water, acidulated with a small quantity of sulphuric acid, in which they are kept for twenty-four hours, and occasionally agitated. They are then well rubbed with cloths, that the surface may be perfectly clean. The tin is fused in a pot, the surface of which is covered with an oily or resinous matter, to prevent its oxidation.

The plates of iron are then immersed in the melted tin, and are either moved about in the liquid metal, or are dipped several different times. They are then taken out, and rubbed with saw-dust or bran, to remove the impurities from the surface.

TITANIUM. See Chemistry.

TITHES, are the tenth part of the increase yearly arising and renewing from the profits of lands, the stock upon lands, and the personal industry of the inhabitants. And hence they are usually divided into three kinds, prædial, mixed, and personal.

TITLE, in law, denotes any right which a person has to the possession of a thing; or an authentic instrument, whereby he can prove his right.

TOBACCO, in botany, a genus of the pentandria monogynia class and order. Natural order of Luridæ. Essential character, corolla funnel-form, with a plaited border; stamina inclined; capsule two-valved, two-celled. There are seven species, of which N. rustica. English tobacco seldom rises more than three feet in height, having smooth alternate leaves upon short foot-stalks, flowers in small loose branches on the tops of the stalks of a yellow colour, appearing in July, which are succeeded by roundish capsules, ripening in the autumn. Sir Walter Raleigh, on his return from America, is said to have first introduced the smoking of tobacco into England. In the house in which he lived at Islington, are his arms, with a tobacco plant on the top of the shield. It is remarkable that tobacco has prevailed over the original name, petum, in all the European languages, with very little variation, and even in Tartary and Japan. Tobacco is derived from the island Tobago. Petum is the Brazilian name.

TODUS, the *tody*, in ornithology, a genus belonging to the order of picæ. The beak is slender, depressed, broad, and the base beset with bristles; the nostrils are small and oval; the toes are placed three before and one behind; the middle are connected to the outer. There are 15 species, according to Dr. Latham.

TOLUIFERA, the *balsam* of *tolu-tree*, a genus of plants of the class decandria, and order monogynia. The calyx is five-toothed, bell-shaped; petals five, obcordate; style none. There is only one species, the balsamum.

This balsam possesses the same general virtues with the balsam of Gilead, and that of Peru. It is, however, less heating and stimulating, and may, therefore, be employed with more safety. It has been chiefly used as a pectoral, and is said to be an efficacious corroborant in gleets and seminal weaknesses. It is directed by the Pharmacopœias in the syrupus tolutanus, tinctura tolutana, and syrupus balsamicus.

TOMBAC, a metal composed of copper and arsenic. See Arsenic.

TON WEIGHT, 20 hundred

TONE, or *Tune*, in music, a property of sound whereby it comes under the relation of grave and acute; or it is the degree of elevation any sound has, from the degree of swiftness of the vibrations of the parts of sonorous bodies.

TONNAGE, a custom or impost due for merchandize brought or carried in tons from or to other nations after a certain rate in every ton.

TONTINE, a species of increasing annuity on which money is sometimes borrowed, either for the service of the state, or for erecting bridges, churches, theatres, taverns, and other expensive buildings. It is usually divided into a certain number of shares, for each of which a

life is nominated, and a certain annual sum being set apart for payment of interest on the money advanced, the same sum is to continue to be annually divided among the surviving nominees, by which means their annuities increase as the number of shares are reduced, till the whole are extinct.

TOP-*nautical*, an instrument to serve instead of the common artificial horizon used at sea for astronomical observations. The idea, we believe, originated with Mr. Serson, who was lost on-board of his Majesty's ship Victory about the middle of the last century. He observed, that when a top was spun, its upper surface directed itself, in the course of two minutes after it was set up, in a truly horizontal plane; and that this plane was not at all disturbed by any motion or inclination of the box on which it was placed; from which he inferred that it might be used advantageously as an artificial horizon. The ingenious Mr. Troughton has recently taken up the idea which had been long abandoned, and has brought the instrument to a great degree of perfection. It consists of a brass cylinder open at bottom, and terminated at the top by a circle of dark glass; the diameter about four inches, and the depth about 1½ inch. The newest form, however, is that of an inverted frustum of a cone; the base or lower surface about four inches, its height about 2½ inches; and the upper surface about six inches in diameter. The reflecting plane rests on a steel cup, half an inch wide, and on a steel point, which descends about half an inch below the upper surface of the frustum. To this beautiful contrivance motion is communicated by a train of wheel work. When the velocity is considered sufficient, the top is suddenly disengaged from the wheel work, and revolves alone with a velocity which has been calculated to be about 30 miles an hour. While thus revolving, the images of the objects reflected from the plate of glass appear to be absolutely fixed.

TOPAZ. See MINERALOGY.

TOPOGRAPHY, a description or draught of some particular place, or small tract of land, as that of a city or town, manor or tenement, field, garden, house, castle, &c. such as surveyors set out in their plots, or make draughts of, for the information and satisfaction of the proprietors.

TORNADO, a sudden and vehement gust of wind from all points of the compass, frequent on the coast of Guinea.

A tornado seems to partake much of the nature of a whirlwind, or perhaps of a water-spout, but is more violent in its effects. It commences very suddenly, several clouds being previously drawn together, when a spout of wind, proceeding from them, strikes the ground, in a round spot of a few rods or perches diameter, and proceeds thus half a mile or a mile. The proneness of its descent makes it rebound from the earth, throwing such things as are moveable before it, but some sideways or in a lateral direction from it. A vapour, mist, or rain, descends with it, by which the path of it is marked with wet. The following is a description of one which happened a few years since at Leicester, about fifty miles from Boston, in New England: it happened in July, on a hot day, about four o'clock in the afternoon. A few clouds having gathered westward, and coming overhead, a sudden motion of their running together in a point being observed, immediately a spout of wind struck the ground at the west of a house, and instantly carried it away, with a negro man in it, who was afterwards found dead in the path of it. Two men and a woman, by the breach of the floor, fell into the cellar; and one man was driven forcibly up into the chimney-corner. These were preserved, though much bruised: they were met with a vapour or mist, as were the remains of the floor, and the whole path of the spout. This wind raised boards, timbers, &c. A joist was found on one end, driven nearly three feet into the ground. The spout probably took it in its elevated state, and drove it forcibly down. The tornado moved with the celerity of a middling wind, and constantly declined in strength till it entirely ceased.

TORPEDO. See RAY.

TORTOISE-SHELL, the shell of the testaceous animal called a tortoise; used in inlaying, and in various other works, as for snuff-boxes, combs, &c.

TOUCH, or FEELING, *sense of.* The sense of feeling differs from the other senses in belonging to every part of the body, external or internal, to which nerves are distributed. The term touch is most correctly applied to the sensibility which is diffused over the surface of the body. Touch exists with the most exquisite degree of sensibility at the extremities of the fingers and thumbs, and in the lips. The sense of touch is thus very commodiously disposed for the purpose of encompassing smaller bodies, and for adapting itself to the inequalities of larger ones.

The sensations acquired by the sense of feeling are those of heat, hardness, solidity, roughness, dryness, motion, distance, figures, &c. and all those corporeal feelings which arise from a healthy or diseased state of the nerves, and the part of the body to which they belong.

The pains of this sense are more numerous and vivid than those derived from any other sense; and therefore the relicts of them coalescing with one another, constitute the greatest share of our mental pains, that is, pains not immediately derived from sensation. On the other hand, its pleasures being faint and rare, in comparison with others, and particularly those of the taste, have but a small share in the formation of the mental pleasures.

TOUCH-NEEDLE, among assayers, refiners, &c. little bars of gold, silver, and copper, combined together in all the different proportions and degrees of mixture; the use of which is to discover the degree of purity of any piece of gold or silver, by comparing the mark it leaves on the touchstone, with those of the bars.

TOURMALINE. See MINERALOGY.

TOURNEQUET, in surgery, an instrument made of rollers, compresses, screws, &c. for compressing any wounded part, so as to stop hæmorrhages.

TOW *to*, in naval affairs, is to draw a ship, or boat, forward in the water, by means of a rope attached to another vessel or boat, which advances by the effort of rowing or sailing.

TOWER, any high building raised above another, consisting of several stories, usually of a round form, though sometimes square or polygonal; a fortress, a citadel. Towers are built

for fortresses, prisons, &c. as the tower of the Bastile, which was destroyed by the inhabitants of Paris in 1789.

TRACHINUS, Weever, a genus of fishes of the order jugulares: the generic character is, head slightly roughened, compressed; gill-membrane six-rayed; gill-covers serrated on the edge; body compressed, vent situated near the breast.

TRADE, the practice of exchanging goods, wares, money, bills and other articles of value, with the view of advantage or profit. It is generally distinguished into foreign trade, or the export and import of commodities to and from other countries, and the internal or home trade, or that which is carried on within the country, which two branches, however, are rather distinct in appearance than reality; for a very considerable portion of the internal trade, arising from manufactures carried on to supply foreign markets, could not subsist without foreign commerce, while a large part of the returns for manufactures sent abroad being articles for consumption, or raw materials which are converted to use in the different manufactures, depends upon our internal trade, so that the one supports the other, and by their mutual connection and dependence, the foreign and the domestic trade of Great Britain have risen together to their present unparalleled height.

TRAGACANTH. This substance, which is vulgarly called gum-dragon, exudes from a prickly bush, the *astragalus tragacantha*, Linn. which grows wild in the warmer climates, and endures the cold of our own, but does not here yield any gum. This commodity is brought chiefly from Turkey, in irregular lumps, or long vermicular pieces bent into a variety of shapes: the best sort is white, semitransparent, dry, yet somewhat soft to the touch.

Tragacanth is usually preferred to the other gums for making up troches, and other like purposes, and is supposed likewise to be the most effectual as a medicine; but on account of its imperfect solubility, is unfit for liquid forms. It is commonly given in powder with the addition of other materials of similar intention; thus, to one part of gum-tragacanth are added one of gum-arabic, one of starch, and six of sugar.

TRAGEDY, a drama which represents some grand and serious action, and which has frequently a fatal issue or end. Its genuine object is to purify and moderate the passions, by exhibiting them in their excess, and to hold forth such a picture of the crimes and miseries of mankind as may teach us, by fear, to be prudent, for our own sake; and, by compassion, to be charitable, for the sake of others.

TRAJECTORY, a term often used, generally for the path of any body moving either in a void, or in a medium that resists its motion; or even for any curve passing through a given number of points.

TRAMMELS, in mechanics, an instrument used by artificers for drawing ovals upon boards, &c. One part of it consists of a cross with two grooves at right angles; the other is a beam carrying two pins which slide in those grooves, and also the describing pencils.

TRANSCENDENTAL or **Transcendant**, something elevated or raised above other things, which passes and transcends the nature of other inferior things.

The term has been ostentatiously applied to the metaphysical speculations of Kant, hence called the transcendental philosophy; but with what degree of propriety this assumption is made, remains to be proved.

TRANSIT, in astronomy, signifies the passage of any planet, just by or over a fixed star, or the sun; and of the moon in particular, covering or moving over any planet.

Transit Instrument. See **Observatory.**

TRANSITION, in music, the softening a disjunct interval by the introduction of intermediate sounds. In harmony, transition is the changing the genus, or mode, in a sensible but regular manner.

Transition Rocks. See **Mineralogy.**

TRANSMUTATION, the act of transforming, or changing one nature, into another. Nature, Sir Isaac Newton observes, seems delighted with transmutations: he goes on to enumerate several kinds of natural transmutations; gross bodies, and light, he suspects, may be mutually transmuted into each other; and adds, that all bodies receive their active force from the particles of light, which enter their composition.

TRANSPARENCY, in physics, a quality in certain bodies whereby they give passage to the rays of light, in contradistinction to opacity, or that quality of bodies which renders them impervious to the rays of light.

TRANSPORTATION, the act of conveying or carrying a thing from one place to another.

Transportation is a kind of punishment, or more properly an alleviation or commutation of punishment, for criminals convicted of felony; who for the first offence, unless it is an extraordinary one, are generally transported to the plantations (at present to New South Wales), there to bear hard labour for a term of years; within which, if they return, they are executed without further trial than identifying their persons.

TRANSPOSITION, in algebra, the bringing any term of an equation over to the other side.

TRANSUBSTANTIATION, in theology, the conversion or change of the substance of the bread and wine in the eucharist, into the body and blood of Jesus Christ, which the Romish church hold is wrought by the consecration of the priest. This is a main point in the Romish religion, and is rejected by the protestants, the former maintaining the transubstantiation to be real, the latter only figurative; interpreting the text, hoc est corpus meum, "this *signifies* my body;" but the council of Trent stood up strenuously for the literal sense of the verb *est*, and say expressly, that in transubstantiation the body and blood of our Lord Jesus Christ are truly, really, and substantially, under the species of bread and wine. The controversies about this point are almost innumerable, a circumstance not to be wondered at when we reflect on the little attention paid by the generality of the Christian world to the language in which Jesus expressed himself, which was purely symbolical.

TRANSVERSE, something that goes across another, from corner to corner; thus bends and bars, in heraldry, are transverse pieces or bearings.

TRAP, in mineralogy, is a Swedish term signifying stair. It was first applied to desig-

nate a certain class of mountains, composed of nearly horizontal strata, with perpendicular breaks, which were supposed to give a rude resemblance to a flight of stairs.

TRAPEZIUM. See GEOMETRY.

TRAVERSE, in law, signifies sometimes to deny, sometimes to overthrow or undo a thing, or to put one to prove some matter; much used in answer to bills in chancery: or it is that which the defendant pleads or says in bar to avoid the plaintiff's bill, either by confessing and avoiding, or by denying and traversing the material part thereof.

TRAVESTY, or TRAVESTI, a French term, derived from the verb travestir, to disguise one's self, or to appear in masquerade: and hence, travesty is applied to the disfiguring of an author, or the translating him into a style and manner different from his own, by which means it becomes difficult to know him.

TREACLE. See SUGAR, &c.

TREAD-*mill*, a mill erected in a prison for the purpose of grinding corn, differing from other mills only in this, that the moving power is supplied by the prisoners who are stationed on the main wheel for this purpose.

TREASON, in law, is divided into high treason and petty treason. High treason is defined to be an offence committed against the security of the king or kingdom, whether it be by imagination, word, or deed; as to compass or imagine the death of the king, queen, or prince, or to deflower the king's wife, or his eldest daughter unmarried; or his eldest son's wife; or levy war against the king in his realm, adhere to his enemies, counterfeit his great seal, privy seal, or money, or wittingly to bring false money into this realm, counterfeited like the money of England, and utter the same; to kill the king's chancellor, treasurer, justices of either bench, justices in eyre, of assize, or of oyer and terminer, being in their place doing this office; forging the king's sign manual or privy signet, privy seal, or foreign coin current here, or diminishing or impairing current money. In case of treason, a man shall be drawn, hanged, and quartered, and forfeit his lands and goods to the king.

TREASON, *petit.* Whenever a wife murders her husband, a servant his master, or mistress, or an ecclesiastic a prelate, or to whom he owes obedience, every one of these offences is petit treason.

As every petit treason implies a murder, it follows, that the mere killing of a husband, master, or prelate, is not always petit treason; for if there are not such circumstances in the case of killing one of these persons, as would have made it murder in the case of killing any other person, it does not amount to this offence.

There can be no accessary in high treason. And it seems to be always agreed that what would have made a man an accessary before the fact in any other felony, makes him a principal in high treason.

TREASURE TROVE, is where any money or coin, gold, silver, plate, or bullion, is hidden in the earth, or other private place, the owner being unknown: in which case, the treasure belongs to the king, or some other who claims by the king's grant or by prescription. But if he that hid it is known, or afterwards found out, the owner, and not the king, is entitled to it. If it is found in the sea, or upon the earth, it does not belong to the king, but to the finder, if no owner appear.

TREASURER, an officer to whom the treasure of a prince, or corporation, is committed to be kept and duly disposed of.

TREMELLA, a genus of plants of the class of cryptogamia, and natural order of algæ. It is of a gelatinous membranous substance; the parts of the fructification scarcely visible. There are eleven species.

TREMOLITE. See MINERALOGY.

TRENCHES, in fortification, are ditches cut by the besiegers, that they may approach more securely to the place attacked; whence they are also called lines of approach.

TRESPASS, is any transgression of the law, under treason, felony, or misprision of either.

TRET, in commerce, an allowance made for the waste or the dirt, that may be mixed with any commodity, which is always four pounds in every hundred and four pounds weight.

TRIAL, the proceeding of a court of law, when the parties are at issue, such as the examination of witnesses, &c. to enable the court deliberately weighing the evidence given on both sides, to draw a true conclusion, and administer justice accordingly.

TRIANDRIA, in the Linnæan system of botany, a class of plants, the third in order; comprehending all such plants as have hermaphrodite flowers, with three stamina, or male parts, in each; whence the name.

TRIANGLE. See GEOMETRY.

TRIANGULAR COMPASSES, are such as have three legs, or feet, whereby to take off any triangle at once; much used in the construction of maps, globes, &c.

TRICHECUS, the *walrus,* in natural history, a genus of mammalia of the order bruta. Generic character: no fore-teeth in the full grown animal, above or below; tusks in the upper jaw solitary; grinders with wrinkled surfaces; body oblong; lips doubled; hind feet stretched, uniting into a fin. These animals are all natives of the sea, and feed on sea-weeds and shell-fish, but are never known to eat flesh. There are three species, of which the principal are, *Trichecus rosmarus,* the arctic walrus, or the morse. This is an animal of a very inelegant structure. It has a small head to a vast body. Its under lip is covered with bristles nearly of the thickness of a crow-quill. In its upper jaw it has two large tusks from one to two feet in length, and weighing from three to twenty pounds. The walrus sometimes grows to the length of eighteen feet, and the circumference, about the thickest part, of twelve. It is principally found in the high latitudes of the Northern Ocean. These animals are gregarious, and are often seen upon floating masses of ice, in immense numbers, the greater part sleeping, but some always on the watch to give notice of approaching danger. They are harmless when not provoked, but some accounts represent them as highly formidable in a state of irritation, the efforts of many being combined against the enemy, and fastening with their teeth against boats to make holes in them, or draw them to the bottom.

Trichecus borealis, or the whale-tailed manati, inhabits the seas between Kamtschatka and America. These animals live in families, generally consisting of a male and female, and two young ones of different ages, and the at-

tachment of the male to the female is so great, that he will defend her when attacked to the last extremity; and if she happens to be destroyed and dragged to the shore, he will swim for some days off the fatal and detested spot. The manati approaches very nearly to the cete tribe, and its feet are little more than pectoral fins. It attains the immense length of twenty-seven feet, and the weight of four tons. In winter it is extremely lean, and its ribs may be distinctly numbered. It will, when pierced with the harpoon, sometimes adhere to rocks with its feet with uncommon tenacity, and when forced from them by a cord drawn by thirty men or more, is found to have left part of the skin of the feet behind. When any individual is harpooned, others are stated to swim to its aid, endeavouring, some to overturn the boat, others to break the cord, and others again by blows with their tails, striving to dislodge the harpoon. Their sounds somewhat resemble the snorting of a horse. They are never seen on land.

TRICHIURUS, a genus of fishes of the order apodes; the generic character is, head stretched forwards, with lateral gill-covers; teeth ensiform, semisagittate at the tips; gill-membrane seven-rayed; body ensiform, compressed, with subulate finless tail.

TRIFOLIUM, *trefoil* or *clover*, a genus of plants of the class diadelphia, and order decandria, and in the natural system ranging under the 22d order, papilionaceæ. The flowers are generally in round heads; the pod is scarcely longer than the calyx, univalve, not opening, deciduous. The leaves are three together. There are 51 species; of which 17 are natives of Britain.

TRIGONOMETRY. The business of this important science is to find the angles where the sides are given; and the sides of their respective ratios, when the angles are given; and to find sides and angles, when sides and angles are partly given. To effect this, it is necessary not only that the peripheries of circles, but also certain right lines in and about circles, be supposed divided into certain numbers of parts. The ancients, feeling the necessity of such a pre-division, portioned the circles into 360 equal parts, which they called degrees; each degree was again dividid into 60 equal parts, called minutes; and each minute comprised 60 equal parts, called seconds. The moderns have improved upon this division by the addition of a nonius, or vernier, which may be carried to any extent, but is usually limited to decimating the seconds; noting each tenth part thereof.

The following definitions will be found useful: 1. The complement of an arc is the difference thereof from a quadrant: thus, if an arc measures 60 deg. the complement is 30 deg. 2. A chord, or subtense, is a right line drawn from one to the other end of an arc. 3. The sine, or right sine, of an arc, is a perpendicular falling from one end of an arc to the radius drawn, at right angles thereto, towards the other end of the arc. Hence it is clear that an arc of 60 deg. must have its secant, its radius, and its chord, all of the same length, forming an equilateral triangle. The secant and radius both proceed from the centre, but all sines are parallel to a vertical line passing through the centre and invariably fall upon a dian[illegible]r; drawn perpendicular to that right line.

For the same reason that we avoided giving a system of arithmetic in this little work, we may perhaps be expected to pass by the doctrin of trigonometry; but as works on this subject are much more expensive than works on common arithmetic, we shall here subjoin the leading rules for plane trigonometry.

Case I. When two of the three given things are a side and its opposite angle, to find the rest.

Rule. The sides of any plane triangle are to each other as the sines of their opposite angles, and vice versa:—That is,

As any side is to the sine of its opposite angle, so is the sine of any other angle to its opposite side.

Or, As the sine of any angle is to its opposite side, so is the sine of any other angle to its opposite side.

Hence, to find an angle, begin the proportion with a side opposite to a given angle; and to find a side, begin with an angle opposite to a given side.

Example I. In the plane triangle ABC, fig. 5, plate LI.

$$\text{Given}\begin{cases}AC\ 236\\ BC\ 350\\ \angle B\ 38^\circ\ 40'\end{cases}\text{yards. Required the other parts.}$$

By Calculation.

As side AC	-	236		2.3729120
				7.6270880
Is to sine ∠B	-	38° 40′		9.7957330
So is side BC	-	350	-	2.5440680
To Sine ∠A	67° 51′	or	112° 6′	9.9668890
	38° 40′		38° 40′	
Sum	106° 31′	or	150° 46′	
Subtract	180° 0′		180° 0′	
Leaves	73° 26′	or	29° 14′ ∠C	

Then,

: Sine ∠ B 36° 40′	9.7957330
	0.2042670
: Side AC 236 -	2.3729120
: : Sine ∠ C 29° 14′	9.6887467
: Side AB 184.47	2.2659257

Case II. When two sides and their included angle are given, to find the rest.

Rule as the sum of any two sides of a plane triangle, is to their difference, so is the tangent of half the sum of their opposite angles, to the tangent of half their difference.

Then the half difference of these angles, added to their half sum, gives the greater angle, and subtracted from it gives the less.

And as all the angles are now known, the remaining side may be found by Case I.

Note. Instead of the tangent of half the sum of the two unknown angles, we may use the co-tangent of half the given angle, or the tangent of half its supplement, which are all equal to each other.

Example. In any plane triangle ABC,

$$\text{Given}\begin{cases}AB\ 1075\\ BC\ 2394\\ \angle B\ 34^\circ\ 46'\end{cases}\text{feet. Required the rest.}$$

By Calculation.

$AB + BC$ 3469 - 3.54

6.4597957
$AB \backsim BC$ 1319 3.1202448
.: Tan. $\frac{A+C}{2}$ 72° 37′ 10.5043702

Tan. $\frac{A \backsim C}{2}$ 50° 32′ 10.0844107

Sum 123° 9′ $\angle A$
Diff. 22° 5′ $\angle C$.

Then,
: Sine $\angle A$ 123° 9′ or 56° 51′ 9.9228509

0.0771491
: Side BC - 2394 - 3.3791241
:: Sine $\angle B$ - 34° 46′ - 9.7560544

Side AC - 1630.5 - 3.2123276

Case III. When the three sides are given, to find the angles.

Rule. Make the longest side the base, and let fall a perpendicular upon it from the opposite angle.

Then, as the base or sum of its segments, is to the sum of the other two sides, so is the difference of those sides, to the difference of the segments of the base.

And half this difference, being added to half the base, will give the greater segment; and subtracted from it, will give the less.

Then, in each of the right-angled triangles, formed by the perpendiculars, there will be known two sides and an angle opposite to one of them; from whence the other angles may be found, by Case I.

Example I. In any plane triangle ABC, fig. 6.

Given $\begin{cases} AB\ 464 \\ AC\ 348 \\ BC\ 690 \end{cases}$ yards. Required the angles.

By Calculation.

Having let fall the perpendicular AD, it will be
: BC or $BD + DC$ 690 - 2.8388941

7.1611509
: $AB + AC$ 812 - 2.9095560
:: $AB \backsim AC$ 116 - 2.0644580

: $BD \backsim DC$ 136.51 2.1351649

$$\text{Hence } \frac{690 + 136.51}{2} = 413.25 = BD.$$

$$\text{And } \frac{690 - 136.51}{2} = 276.75 = CD.$$

Then, in the triangle ABD, right-angled at D,
: AB - 464 - 2.6665180
: BD - 413.25 - 2.6162129
Sine $\angle D$ - 90° - 10.0000000

Sine $\angle BAD$ 62° 57′ - 9.9496949
90° 0′

27° 3′ $\angle B$.

And, in the triangle ACD, right-angled at D,
: AC - 348 - 2.5415792
: DC - 276.75 - 2.4420876
:: Sine $\angle D$ 90° 0′ - 10.0000000

Sine $\angle CAD$ 52° 40′ 9.900508
90° 0′

37° 20′ $\angle C$
Also 62° 57′ $\angle BAD$
And 52° 40′ $\angle CAD$

Makes 115° 37′ $\angle BAC$.

Whence $\angle B = 27° 3′$, $\angle C = 37°'25$, and $\angle BAC = 115° 37′$.

Case IV. In any right angled triangle, As radius is to the tangent of either of the acute angles, so is the side adjacent to that angle, to the side opposite to it; and vice versa.

Example I. In any right-angled plane triangle ABC, fig. 7.

Given $\begin{cases} BC\ 324 \\ \angle B\ 53° 7′ 48″ \end{cases}$ Required the other parts.

By Calculation.

: Rad. or sine - 90° - 10.0000000
: Tan. $\angle B$ - 53° 7′ 48″ 10.1249371
:: Side BC 324 2.5105450

: Side AC 432 2.6354821

: Sine $\angle A$ or cos. $\angle B$ 53° 7′ 48′ 9.7781524
: Side BC - - 324 - 2.5105450
: Rad. or sine $\angle C$ - 90° - 10.0000000

: Side AB - - 540 - 2.7323926

And 90° 53° 7′ 48″ = 36° 52′ 12″ $\angle A$.

TRILLION, in arithmetic, a billion of billions.

TRIM *of a ship*, her best posture, proportion of ballast, and hanging of her masts, &c. for sailing. To find the trim of a ship is to find the best way of making her sail swiftly, or how she will sail best.

TRINGA, *sandpiper*, a genus of birds belonging to the order of grallæ. The bill is somewhat tapering, and of the length of the head; the nostrils are small; the toes are four in number and divided, the hind toe being frequently raised from the ground. According to Dr. Latham, there are 45 species, of which 18 are British.

TRINITARIANS, those who believe in the trinity: those who do not believe therein, being called anti-trinitarians.

TRINITY-*house*, a kind of college at Deptford, belonging to a company or corporation of seamen, who, by the king's charter, have power to take cognizance of those persons who destroy sea-marks, and to get reparation of such damages; and to take care of other things belonging to navigation. At present, many gentry and some nobility are members of that community.

TRINOMIAL, or Trinomial root, in mathematics, is a root consisting of three parts connected together by the signs + or —, as $x + y + z$, or $a + b - c$.

TRIO, in music, a part of a concert wherein three persons sing; or more properly a musical composition consisting of three parts. Trios are the finest kinds of composition, and these are what please most in concerts.

TRIPLE *time*, in music, a time consisting of three measures in a bar; the two first of which are beat with the hand or foot down and the third marked by its elevation

TRIPOLI, a mineral found sometimes in an earthy form, but more generally indurated. Its texture is earthy. Specific gravity 2 to 2.5. It absorbs water, feels harsh and dry. Scarcely adheres to the tongue; takes no polish from the nail; does not stain the fingers. Colour gene- [illegible] also different kinds of yellow, brown, and white.

TRISECTION, or TRISSECTION, the dividing a thing into three. The term is chiefly used in geometry, for the division of an angle into three equal parts. The trisection of an angle geometrically, is one of those great problems whose solution has been so much sought by mathematicians for these two thousand years, being in this respect on a footing with the quadrature of the circle, and the duplicature of the cube angle.

TRITICUM, *wheat*, a genus of plants of the class triandria, and order digynia, and in the natural system ranging under the fourth order, gramina. The calyx is bivalve, solitary, and generally containing three florets; the corolla is bivalve, one valve being bluntish, the other acute. There are 19 species.

TRITOMA, a genus of insects of the coleoptera order. The generic character is, antennæ clavate, the club perfoliate; lip emarginate; anterior feelers hatched-shaped; shells as long as the body. There are 10 species.

TRITON, a genus of vermes mollusca. The generic character is, body long: mouth with an involute spiral proboscis; tentacula, or arms twelve, viz. six on each side, divided nearly to the base, the end ones cheliferous. There is only a single species.

TROCHAIC VERSE, in the Latin poetry, a kind of verse, so called because the trochees chiefly prevail, as the iambus does in the iambic. It generally consists of seven feet and a syllable; the odd feet, for the most part, consist of trochees, though a tribrachys is sometimes admitted, except in the seventh foot; these two feet are likewise used in the other places, as is also the spondæus, dactylus, and anapæstus. The following is an example:

1 2 3 4 5 6
Solus | aut rex | aut po | eta | non quot | annis |
7 ½
nasci | tur.

TROCHEE, in the Greek and Latin poetry, a foot consisting of two syllables; the first long and the second short, as in the words *mūsă* and *sērvăt*.

TROCHILUS, *humming bird*, a genus of birds belonging to the order of picæ.—The rostrum is subulate, filiform, and longer than the head, the apex being tubular; the upper mandible sheaths the lower. The tongue is filiform and tubulous, the two threads coalescing; the feet are slender and fit for walking; the tail has ten feathers. There are 65 species, none of which are natives of Britain. They are all remarkable for the beauty of their colours, and most of them for the smallness of their size, though some are eight or nine inches in length. They are divided into two families, viz. those with crooked bills, and those with straight bills.

TROGON, or *curucia*, a genus of birds of the order picæ. The generic character is. bill shorter than the head, sharp edged, hooked, the mandibles serrate, at the edge; feet formed for climbing. There are nine species.

TRONAGE, the mayor and commonalty of the city of London, are ordained keepers of the beams and weights for weighing merchants commodities, with power to assign clerks, porters, &c. of the great beam and balance, which weighing of goods and wares is called tronage.

TROPÆOLUM, the *Indian cress*, or *nasturtium*, a genus of the octandria-monogynia class of plants, the flower of which consists of five roundish petals inserted into the divisions of the cup; the two upper petals are sessile; the three others have very long and barbated ungues: the fruit consists of three convex capsules, fulcated, and striated on one side, and angular on the other; the seeds are three, gibbous on one side, and angulated on the other, but upon the whole somewhat roundish, and striated deeply. There are five species.

TROPHY, *tropæum*, among the ancients a pile or heap of arms of a vanquished enemy, raised by the conqueror in the most eminent part of the field of battle. The trophies were usually dedicated to some of the gods, especially Jupiter. The name of the deity to whom they were inscribed, was generally mentioned, as was that also of the conqueror.

TROPICS. See ASTRONOMY, and GEOGRAPHY.

TROVER is the remedy prescribed by the law, where any person is in possession of the property of another, which he unlawfully detains.

TROUT. See SALMO.

TROY-*weight*, one of the most ancient of the different kinds used in Britain. The ounce of this weight was brought from Grand Cairo in Egypt, about the time of the crusades, into Europe, and first adopted in Troyes, a city of Champagne, whence the name. The pound English troy contains 12 ounces, or 5760 grains.

TROY-*weight*, *Scots*, was established by James VI., in the year 1618, who enacted, that only one weight should be used in Scotland, viz. the French troy stone of 16 pounds, and 16 ounces in the pound. The pound contains 7600 grains, and is equal to 17 oz. 6 dr. avoirdupois. The cwt. or 112 lb. avoirdupois, contains only 103 lb. 2¼ oz. of this weight, though generally reckoned equal to 104 lb. This weight is nearly, if not exactly, the same as that of Paris and Amsterdam; and is generally known by the name of Dutch weight. Though prohibited by the articles of union, it is still used in weighing iron, hemp, flax, most Dutch and Baltic goods, meal, butchers-meat, unwrought pewter, and lead, and some other articles.

TRUCE, in war, denotes a suspension of arms, or a cessation of hostilities between two armies, in order to settle articles of peace, bury the dead, or the like.

TRUFFLES, in natural history, a kind of subterraneous puff-ball, being a species of fungi, which grows under the surface of the earth. See LYCOPERDON.

TRUMPET, the loudest of all portable wind instruments, and consisting of a folded tube generally made of brass, and sometimes of silver.

TRUMPET, *hearing*, is an instrument to assist the hearing of persons who are deaf. Instruments of this kind are formed of tubes, with a

wide mouth, and terminating in a small canal, which is applied to the ear. The form of these instruments evidently shows how they conduce to assist the hearing; for the greater quantity of the weak and languid pulses of the air being received and collected by the large end of the tube, are reflected to the small end, where they are collected and condensed; thence entering the ear in this condensed state, they strike the tympanum with a greater force than they could naturally have otherwise done.

TRUMPET, *speaking*, is a tube from six to fifteen feet long, made of tin, perfectly straight, and with a very large aperture; the mouth-piece being large enough to receive both lips. It is used for magnifying sound, particularly that of speech, and thus causing it to be heard at a great distance.

TRUNCATED, in general, is an appellation given to such things as have, or seem to have, their points cut off.

TRUNCHEON, a short staff, or battoon, used by kings, generals, and great officers, as a mark of their command.

TRUNNIONS, or **TRUNIONS** *of a piece of ordnance*, are those knobs or bunches of the gun's metal which bear her up on the cheeks of the carriage.

TRUSS, a bundle, or certain quantity of hay, straw, &c. A truss of hay is to contain fifty-six pounds, or half an hundred weight; thirty-six trusses make a load.

TRUSS, is also used for a sort of bandage or ligature, made of steel, or the like matter, wherewith to keep up the parts, in those who have hernias or ruptures.

TRUST, is a right to receive profits of land, and to dispose of the land in equity; and one holding the possession and disposing thereof at his will and pleasure, are signs of trust.

TUBE, in general, pipe, conduit, or canal; a cylinder, hollow within side, either of lead, iron, wood, glass, or other matter, for the air, or some other fluid, to have a free passage or conveyance through.

TUBE, in astronomy, is sometimes used for a telescope, or, more properly, for that part into which the lenses are fitted, and by which they are directed and used.

TUBULARIA, a genus of zoophyta: stem tubular, simple or branched, fixed by the base: animal proceeding from the end of the tube, and having its head crested with tentacula. There are 26 species.

TUFAS, beds of lime deposited on vegetables, which by their destruction give great lightness and porousness to the mass.

TULIPA, *tulip*, a genus of plants of the class hexandria, and order monogynia, and in the natural system ranging under the 10th order, coronariæ. The corolla is hexapetalous and campanulated, and there is no stile. The species of this genus are five; the sylvestris, or Italian yellow tulip, a native of the south of Europe; the gesneriana, or common tulip, a native of the Levant: the breyniana, or Cape tulip, a native of the Cape of Good Hope, the biflora, and the suavolens.

TUMOUR, or **TUMOR**, in medicine and surgery, a preternatural rising or hard swelling on any part of the body.

TUN, or **TON**, originally signifies a large vessel or cask of an oblong form, biggest in the middle, and diminishing towards its two ends, girt about with hoops, and used for stowing several kinds of merchandize, for convenience of carriage; as brandy, oil, sugar, skins, hats, &c. This word is also used for certain vessels of extraordinary bigness, serving to keep wine for several years.

TUN is also a certain measure for liquids, as wine, oil, &c.

TUN is also a certain weight, whereby the burden of ships, &c. are estimated.

TUNE, or **TONE**, in music, that property of sounds whereby they come under the relation of acute and grave to one another.

TUNGSTEN. See CHEMISTRY.

TUNGSTEN, a mineral found in Sweden, of an opaque white colour and great weight, whence its name tungsten, or ponderous stone. This ore was analysed by Scheele, who found that it was composed of lime and a peculiar earthy-like substance, which from its properties he called tungstic acid.

TUNGSTIC *acid*. The substance called tungstic acid by Scheele and Bergman was discovered by Scheele in 1781. This philosopher obtained it from the tungstat of lime, by treating it with nitric acid and ammonia alternately. The acid dissolves the lime, and the ammonia combines with the tungstic acid. The ammoniacal solution, when saturated with nitric or muriatic acid, deposits a white powder, which is the tungstic acid of Scheele.

TUNICA, a kind of waistcoat or under-garment, in use amongst the Romans.

TURBO, the *wreath*, in zoology, a genus of insects belonging to the order of vermes testacea. The animal is of the snail kind; the shell consists of one spiral solid valve, and the aperture is orbicular. There are 66 species.

TURDUS, the *thrush*, a genus of birds belonging to the order of passeres. The bill is straight, bending towards the point, and slightly notched near the end of the upper mandible. The nostrils are oval, half covered with a membrane; the corners of the mouth are furnished with a few slender hairs, and the tongue is slightly jagged at the end. Gmelin enumerates 135 species, the principal of which are:

Turdus viscivorus, or the missel-thrush. This bird is well known throughout Europe, and some think confined to it. In England it is stationary, in some other countries migratory. It builds its nest of moss and leaves in low trees, or rather shrubs, and lays four eggs. It feeds on the berries of holly, hawthorn, and other trees, and on caterpillars and insects. It is valued for food, but far more for that melody, which ought ever to be its security from the gun of the sportsman, and which it frequently commences so early as the very beginning of the year, animating the dulness, and softening the rigour of the season by its delightful song.

Turdus musicus, or the throstle, is nine inches long, and weighs three ounces, being considerably less than the former. It breeds so early as the beginning of April, and sometimes again in each of the two following months. Its nest is made of earth, straw, and moss, and plastered inside with clay. It is never seen in companies in England, where it remains through the whole year: in France it is migratory. Its song commences early in the season, and continues for

nine months, and its notes are so rich and various, that, in the language of Milton, they can "charm all sadness but despair."

Turdus pilaris, or the field-fare, is ten inches long, passes the winter in England, when the season is extremely rigorous, in immense flocks, but in small parties when the winter is mild. These birds are said to have been much esteemed for the table by the Romans. In Sweden they build in high trees. They subsist principally on various sorts of berries.

Turdus merula, or the black-bird, is ten inches long, and found generally throughout Europe. It is fond of solitude, and never, or very rarely, seen in flocks. In summer it haunts orchards and gardens. In winter it secludes far from human society in the recesses of the woods. It lays four or five eggs of a dusky green colour, marked with irregular spots. The note of the male is extremely fine, but too loud for any place except the woods; it begins to sing early in the spring, continues its music part of the summer, desists in the moulting season, but resumes it for some time in September and the winter months.

TURKEY. See MELEAGRIS.

TURMERIC. See CURCUMA.

TURNING, the art of forming hard bodies, as wood, ivory, or iron, into a round or oval shape, by means of a machine called a lathe, of which there are various kinds, and several instruments, as gouges, chisels, drills, formers, and screw-tales, used for cutting what is to be turned into its proper form as the lathe turns round. The lathe should be fixed in a place very well lighted; it should be immoveable, and neither too high nor too low. The puppets should neither be so low as to oblige the workman to stoop in order to see his work properly, nor so high that the little chips, which he is continually driving off, should come into his eyes.

To succeed in turning iron, it is necessary to have a lathe exceedingly strong in all its parts, and exceedingly well fixed. The puppets should be short, and the rest well fixed very near the work; the back of the rest should be two or three lines lower than the iron to be turned.

For turning ovals, a lathe of somewhat different construction is used. The axis or spindle, having on it the pulley over which the band-cord passes for turning the lathe, is fixed between the two puppets so as to turn round easily; one end of it passes through one of the puppets, and to it is firmly fixed a circular plate of brass, so that it turns round along with the spindle. Upon this plate two brazen segments of circles are fastened, the circumferences of which correspond to the circumference of the plate, their chords are parallel and equally distant from the centre of the plate, so that they leave a distance between them. They have a groove in each of them; in these grooves another plate is placed, which exactly fills up the space between the two grooves, but is shorter than the diameter of the larger circular plate on which it is laid. This plate is made to slide in the grooves. To its centre is annexed a short spindle, on which the piece of wood to be turned is fixed. When the lathe is set a going, the circular plate moves round, and carries the piece along with it; the plate of brass on which the piece is fixed, being fixed loosely in the grooves already described, slides down a little every time that the grooves become perpendicular to the floor (and there are particular contrivances to prevent it from sliding down too far); and by these two motions combined (the circular one of the large plate, and the straight one of the small), the circumference of the piece of wood to be turned necessarily describes an oval; and gouges or other tools being applied in the usual manner, supported on the rest, it is cut into an oval accordingly. The small plate may be made to slide, either more or less, in the grooves; and by this contrivance the transverse diameter of the oval, or rather ellipse, may be made longer or shorter, at pleasure.

The art of turning is so extensively applicable, that it would require a volume to describe its uses, and the methods of practising it. Every round thing which is made by human hands, may be referred to this art, as one of its products. The largest columns, the most ponderous artillery, and the minutest pivots of watch-work, with all wheel-work, rotatory machines, vessels, &c. are worked in this method.

TURNPIKE, a gate set up across a road, watched by an officer for the purpose, in order to stop travellers, waggons, coaches, &c. to take toll of them towards repairing or keeping the roads in repair.

TURPENTINE, a resinous juice extracted from several trees. Common turpentine is obtained largely in the pine forests in the south of France, in Switzerland, in the countries on the north of the Pyrenees, in Germany, and in many of the southern States of North America. The greater part of what is consumed in this country is imported from North America The method of obtaining it is by making a series of incisions through the bark of the tree, from which the turpentine exudes, and falls down into holes, or other receptacles at the foot.

TUTENAG. This name is given in India to the metal zinc. It is sometimes applied to denote a white metallic compound, brought from China, called also *Chinese copper*, the art of making which is not known in Europe. It is very tough, strong, malleable, may be easily cast, hammered, and polished; and the better kinds of it, when well manufactured, are very white, and not more disposed to tarnish than silver is. Three ingredients of this compound may be discovered by analysis: namely, copper, zinc, and iron.

TWILIGHT, that light, whether in the morning before sun-rise, or in the evening after sun-set, supposed to begin and end when the least stars that can be seen by the naked eye cease, or begin, to appear. By means of the atmosphere it happens, that though none of the sun's direct rays can come to us after it is set, yet we still enjoy its reflected light for some time, and night approaches by degrees; for after the sun is hidden from our eyes, the upper part of our atmosphere remains for some time exposed to its rays, and from thence the whole is illuminated by reflection.

The beginning and end of twilight has been variously stated, by different observers; but, in our latitude, it may be said to begin and end when the sun is about eighteen degrees below the horizon: hence, when refraction is

allowed for, the atmosphere must be capable of reflecting sensible light at the height of about forty miles.

TYGER. See FELIS.

TYMPAN, among printers, is a double frame, belonging to the press, covered with parchment, on which the blank sheets are laid, in order to receive the impression.

TYMPANUM, or TYMPAN, in mechanics, a kind of wheel placed round an axis or cylindrical beam, on the top of which are two levers or fixed staves, for the more easy turning the axis, in order to raise a weight required.

TYMPANUM *of a machine*, is also used for a hollow wheel, wherein one or more people, or other animals, walk to turn it; such as that of some cranes, calenders, &c.

TYPE, a copy, image, or resemblance of some model. This word is much used among divines, to signify a symbol, sign, or figure of something to come.

TYPE, among letter-founders and printers, the same with letter.

TYPHA, *cat's-tail*, a genus of plants of the class monœcia, and order triandria; and in the natural system ranging under the third order, calamariæ. The amentum of the male flower is cylindrical; the calyx is scarcely distinguishable; there is no corolla. The female has a cylindrical amentum below the male; the calyx is composed of villous hair; there is no corolla, and only one seed fixed on a capillary pappus. Two species.

TYPOGRAPHY. See PRINTING.

U, V.

U, or V, the twentieth letter of our alphabet. In numerals V stands for five; and with a dash added at top, thus $\bar{V}$, it signifies five thousand. In abbreviations, amongst the Romans, V. A. stood for veterani assignati; V. B. viro bono; V. B. A. viri boni arbitratu; V. B. F. vir bonæ fidei; V. C. vir consularis; V. C. C. F. vale, conjux charissime, feliciter; V. D. D. voto dedicatur; V. G. verbi gratia; Vir. Ve. virgo vestalis; VL. videlicet; V. N. quinto nonarum.

VACATION, in law, is the whole time betwixt the end of one term and the beginning of another. This word is also applied to the time from the death of a bishop, or other spiritual person, till the bishopric, or dignity, is supplied with another.

VACCINATION. Inoculation with the vaccine virus, for the purpose of securing against the infection of the small-pox.

VACCINIUM, the *whortle-berry, or bilberry*, a genus of plants of the class octandria, and order monogynia; and arranged in the natural system under the 18th order, bicornes. The calyx is superior; the corolla monopetalous; the filaments inserted into the receptacle; the berry quadrilocular and polyspermous. There are twenty-seven species.

VACUUM, in philosophy, denotes a space empty, or devoid, of all matter or body.

VADE MECUM, or VENI MECUM, a Latin phrase, used in English to express a thing that is very handy and familiar, and which one usually carries about with them; chiefly applied to some favourite book.

VAGINALIS, a genus of birds of the order grallæ; the generic character is, bill strong, thick, conic-convex, compressed, the upper mandible covered above with a moveable horny sheath; nostrils small, placed before the sheath; tongue above round, beneath flattened, pointed at the tip; face naked, papillous; wings with an obtuse excrescence under the flexure; legs strong, four toed, naked a little above the knees; toes rough beneath, claws grooved. There is but a single species.

VAGRANTS, are all persons threatening to run away and leave their wives and children to the parish. All persons unlawfully returning to the parish or place whence they have been legally removed by order of two justices, without bringing a certificate from the parish or place whereto they belong. All persons who have not wherewith to maintain themselves, live idle, and refuse to work for the usual wages given to other labourers in the like work, in the parishes or places where they are. All persons going from door to door, or placing themselves in the streets, highways, or passages, to beg or gather alms in the parishes or places where they dwell. All these shall be deemed idle and disorderly persons, and one justice may commit such offenders (being thereof convicted before him, by his own view, confession, or oath of one witness,) to the house of correction, to hard labour, not exceeding one month. And any person may apprehend and carry before a justice, any such persons going from door to door, or placing themselves in the streets, highways, or passages, to beg alms in the parishes or places where they dwell; and if they shall resist, or escape from the person apprehending them, they shall be punished as rogues and vagabonds.

VALERIANA, a genus of plants of the class triandria and order monogynia, and in the natural system arranged under the 48th order aggregatæ. There is hardly any calyx; the corolla is monopetalous, gibbous at the base, situated above the germen; there is only one seed. Thirty-one species.

VALLISNERIA, in botany, a genus of the diœcia diandria class of plants, with a monopetalous tripartite flower; its fruit is a long, cylindraceous, and unilocular capsule, containing numerous oval seeds. Two species.

VALVE, in hydraulics, pneumatics, &c. is a kind of lid or cover to a tube, vessel, or orifice, contrived to open one way; but which, the more forcibly it is pressed the other way, the closer it shuts the aperture, like the clapper of a bellows.

VALVE, in anatomy, a thin membrane applied on several cavities and vessels of the body, to afford a passage to certain humours going one way, and prevent their reflux towards the place whence they came.

VAN, in sea-language, denotes the foremost division of any naval armament, or the part that usually leads the way to battle, or advances first in the order of sailing.

VANE, in a ship, &c. a thin slip of some

kind of matter, placed on high in the open air, turning easily round on an axis or spindle, and veered about by the wind, to shew its direction or course.

VANES, in mathematical or philosophical instruments, are sights made to slide and move upon cross-staves, fore-staves, quadrants, &c

VAPOUR, in meteorology, a thin humid matter, which, being rarefied to a certain degree by the action of heat, ascends to a particular height in the atmosphere, where it is suspended, until it returns in the form of dew, rain, snow, &c.

VARIABLE, in geometry and analytics, is a term applied by mathematicians to such quantities as are considered in a variable or changeable state, either increasing or decreasing. Variable quantities are generally denoted by the last letters of the alphabet, z, y, x, &c.; while the constant ones are denoted by the leading letters, a, b, c, &c.

VARIANCE, in law, signifies any alteration of a thing formerly laid in a plea; or where the declaration in a cause differs from the writ, or from the deed upon which it is grounded.

VARIATION, in geography and navigation, is the deviation of the magnetical needle, in the mariner's compass, from the true north point, towards either the east or west; or it is an arch of the horizon, intercepted between the meridian of the place of observation and the magnetic meridian. See MAGNETISM and NAVIGATION.

VARNISH, a thick, viscid, shining liquor, used by painters, gilders, and various other artificers, to give a gloss and lustre to their works; as also to defend them from the weather, dust, &c.

A coat of varnish ought to possess the following properties: 1. It must exclude the action of the air, because wood and metals are varnished to defend them from decay and rust. 2. It must resist water; for otherwise the effect of the varnish could not be permanent. 3. It ought not to alter such colours as are intended to be preserved by this means. It is necessary, therefore, that a varnish should be easily extended or spread over the surface, without leaving pores or cavities, that it should not crack or scale, and that it should resist water.

Resins are the only bodies that possess these properties, consequently they must form the basis of every varnish. For this purpose, they must be dissolved, as minutely divided as possible, and combined in such a manner, that the imperfections of those that might be disposed to scale, may be corrected by others.

Lac-varnishes or lacquers consist of different resins in a state of solution, of which the most common are mastich, sandarach, lac, benzoin, copal, amber, and asphaltum. The menstrua are either expressed or essential oils, as also alcohol. For a lac-varnish of the first kind, the common painter's varnish is to be united by gently boiling it with some more mastich or colophony, and then diluted again with a little more oil of turpentine. The latter addition promotes both the glossy appearance and drying of the varnish.

A varnish, of the consistence of thin turpentine is obtained for aerostatic machines, by the digestion of one part of elastic gum, or caoutchouc, cut into small pieces, in thirty-two parts of rectified oil of turpentine. Previously to its being used, however, it must be passed through a linen cloth, in order that the undissolved parts may be left behind.

VARNISH, among medallists, signifies the colours antique medals have acquired in the earth.

VAULT, in architecture, an arched roof, so contrived that the stones which form it sustain each other. Vaults are, on many occasions, to be preferred to soffits or ceilings, as they give a greater height and elevation, and are besides more firm and durable.

VECTOR, in astronomy, a line supposed to be drawn from any planet moving round a centre, or the focus of an ellipsis, to that centre or focus.

VEER, a sea-term variously used. Thus veering out a rope, denotes the letting it go by hand, or letting it run of itself. It is not used for letting out any running-rope, except the sheet.

VEGETABLE. A vegetable is composed of a root, stem, leaves, flowers, fruits, and seeds; and when all these different parts are fully developed, the vegetable is said to be perfect. When any are deficient, or at least less obvious, the vegetable is said to be imperfect.

VEIN, among miners, is that space which is bounded with woughs, and contains ore, spar, canck, clay, chirl, croil, browhen, pitcher-chirt, cur, which the philosophers call the mother of metals, and sometimes soil of all colours. When it bears ore, it is called a quick vein; when no ore, a dead vein.

VELVET, a rich kind of stuff, all silk, covered on the outside with a close, short, fine, soft shag, the other side being a very strong close tissue. The nap, or shag, called also the velveting, of this stuff, is formed of part of the threads of the warp, which the workman puts on a long narrow-channelled ruler or needle, which he afterwards cuts, by drawing a sharp steel tool along the channel of the needle to the ends of the warp.

VENEERING, or VANEERING, a kind of inlaying, whereby several thin slices or leaves of fine woods, of different kinds, are applied and fastened on a ground of some common wood. There are two kinds of inlaying: the one, which is the most common and more ordinary, goes no farther than the making of compartments of different woods; the other requires much more art, in representing flowers, birds, and the like figures. The first kind is properly called veneering; the latter is more properly called marquetry. The wood used in veneering is first sawed out into slices or leaves about a line in thickness; *i. e.* the twelfth part of an inch. In order to saw them, the blocks, or planks, are placed upright, in a kind of sawing press. These slices are afterwards cut into narrow slips, and fashioned divers ways, according to the design proposed; then the joints having been exactly and nicely adjusted, and the pieces brought down to their proper thickness, with several planes for the purpose, they are glued down on a ground or block, with good strong glue. The pieces being thus jointed and glued, the work, if small, is put in a press; if large, it is laid on a bench covered with a board, and pressed down with poles or pieces of wood one end of which reaches to the ceiling of th

room, and the other bears on the board. When the glue is thoroughly dry, it is taken out of the press and finished; first with little planes, then with divers scrapers, some of which resemble rasps, which take off the dents, &c. left by the planes. After it has been sufficiently scraped, they polish it with the skin of a sea-dog, wax, and a brush, or polisher of shave-grass; which is the last operation.

VENTRILOQUISM, an art by which certain persons can so modify their voice, as to make it appear to the audience to proceed from any distance, and in any direction. Some faint traces of this art are to be found in the writings of the ancients; and it is the opinion of M. De la Chapelle, who in the year 1772 published an ingenious work on the subject, that the responses of many of the oracles were delivered by persons thus qualified, to serve the purposes of delusion. As the ancient ventriloquists, when exercising their art, seemed generally to speak from their own bellies, the name by which they were designed was abundantly significant: but it is with no great propriety that modern performers are called ventriloquists, and their art ventriloquism, since they appear more frequently to speak from the pockets of their neighbours, or from the roof or distant corners of the room, than from their own mouths or their own bellies.

The history of ventriloquism affords some very striking instances of the power which it exercises over the imagination. About the beginning of the last century, the famous Tom King, who is said to have been the first man who gave public lectures on experimental philosophy in this country, was attended by the whole fashionable world, for a succession of many nights, to hear him "kill a calf." This performance was done in a separated part of the place of exhibition, into which the exhibitor retired alone; and the imagination of his polite hearers was taxed to supply the calf and three butchers, besides a dog who sometimes raised his voice, and was checked for his unnecessary exertions. It appears, from traditional narrative, that the calf was heard to be dragged in, not without some efforts and conversation on the part of the butchers, and noisy resistance from the calf; that they conversed on the qualities of the animal, and the profits to be expected from the veal; and that, as they proceeded, all the noises of knife and steel, of suspending the creature, and of the last fatal catastrophe, were heard in rapid succession, to the never-failing satisfaction of the attendants; who, upon the rise of the curtains, saw that all these imaginary personages had vanished, and Tom King alone remained to share the praise.

VENUE, in law, the neighbourhood whence juries are to be summoned for trial of causes.

VENUS, in astronomy, one of the inferior planets, revolving round the sun in an orbit between that of Mercury and the Earth.

VENUS, in zoology, a genus of insects belonging to the order of vermes testacea. This animal is a tethys; the shell is bivalve; the hinge with three teeth near each other, one placed longitudinally and bent inwards.

VEPRECULÆ, diminutive from vepres, "a briar or bramble," the name of the 31st order in Linnæus's Fragments of a Natural Method.

VERB, in grammar, a word serving to express what we affirm of any subject, or attribute to it.

VERDEGRIS, is an acetat of copper, useful in the arts as a pigment.

VERDEROR, a judicial officer of the king's forests, chosen by the king's writ in the full county court of the same shire, within the forest where he dwells; he is sworn to maintain and keep the assizes of the forest, and to view, receive, and enrol the attachments and presentments, of all manner of trespasses of vert and venison in the forest.

VERDICT, the answer of a jury made upon any cause, civil or criminal, committed by the court to their examination: and this is twofold, general or special. A general verdict is that which is given or brought into the court in like general terms to the general issue; as guilty or not guilty generally. A special verdict is, when they say at large that such a thing they find to be done by the defendant, or tenant, so declaring the course of the fact, as in their opinion it is proved; and as to the law upon the fact, they pray the judgment of the court: and this special verdict, if it contain any ample declaration of the cause from the beginning to the end, is also called a verdict at large.

VERDITER is a blue pigment, obtained by adding chalk or whiting to the solution of copper in aquafortis.

VERGE signifies the compass of the king's court, which bounds the jurisdiction of the lord steward of the household, and which is thought to have been twelve miles round.

The term verge is also used for a stick or rod, whereby one is admitted tenant to a copyhold estate, by holding it in his hand and swearing fealty to the lord of the manor.

VERGERS, certain officers of the courts of king's-bench and common-pleas, whose business it is to carry white wands before the judges. There are also vergers of cathedrals, who carry a rod tipped with silver before the bishop, dean, &c.

VERJUICE, a kind of harsh, austere vinegar, made of the expressed juice of the wild apple, or crab. The French give this name to unripe grapes, and to the sour liquor obtained from them.

VERMES, in natural history, the last class of the animal kingdom, according to the Linnæan system. The animals in this class are not merely those commonly known by the name of worms, but likewise those which have the general character of being "slow in motion, of a soft substance, extremely tenacious of life, capable of reproducing such parts of their body as may have been taken away or destroyed, and inhabiting moist places." There are five orders in this class, viz. the

Infusoria
Intestina
Mollusca.
Testacea
Zoophyta

VERMICELLI, a composition of flour, cheese, yolks of eggs, sugar, and saffron, reduced to a paste, and formed into long slender pieces, like worms, by forcing it with a piston through a number of little holes.

VERNIER SCALE, a scale excellently adapted for the graduation of mathematical instruments, thus called from its inventor Peter Vernier, a person of distinction in the Franche Compté. Vernier's method is derived from the following principle:—If two equal right lines,

or circular arcs, A, B, are so divided, that the number of equal divisions in B is one less than the number of equal divisions of A, then will the excess of one division of B above one division of A, be compounded of the ratios of one of A to A, and of one of B to B.

VERSE. See POETRY.

arch.

VERTICAL *circle*, in astronomy, a great circle of the sphere passing through the zenith and nadir, and cutting the horizon at right angles: it is otherwise called azimuth.

VESPA, *wasp*, a genus of insects of the order hymenoptera. The generic character is, mouth with jaws, without proboscis; upper wings pleated; sting concealed; eyes lunated; body smooth.

The genus vespa is of great extent, 140 species; and is remarkable, like that of apis or bee, for the singular dexterity with which it constructs its habitation, which in many species is of considerable size. The common wasp, or vespa vulgaris, is known to every one. The nest of this species is a highly curious structure, and is prepared beneath the surface of some dry bank, or other convenient situation. Its shape is that of an upright oval, often measuring ten or twelve inches at least in diameter: it consists of several horizontal stages or stories of hexagonal cells, the interstices of each story being connected at intervals by upright pillars; and the exterior surface of the nest consists of a great many layers or pieces, disposed over each other in such a manner as best to secure the interior cavity from the effects of cold and moisture; the whole nest, comprising both walls and cells, is composed of a substance very much resembling the coarser kinds of whitish-brown paper, and consists of the fibres of various dry vegetable substances, agglutinated by a tenacious fluid discharged from the mouths of the insects during their operations. The female wasps deposit their eggs in the cells, one in each cell appropriated for that purpose; from these are hatched the larvæ or maggots, which bear a near resemblance to those of bees; they are fed by the labouring wasps with a coarse kind of honey, and when arrived at their full size, close up their respective cells with a fine tissue of silken filaments, and, after a certain period, emerge in their complete or perfect form. The male insect, like the male bee, is destitute of a sting. The society or swarm of the common wasp, consists of a vast number of neutral or labouring insects, a much smaller number of males, and still fewer females. They do not, like bees, prepare and lay up a store of honey for winter use; but the few which survive the season of their birth, remain torpid during the colder months. Wasps in general are both carnivorous and frugivorous.

VESPERTILIO, *bat*, a genus of mammalia, of the order primates. The generic character is, teeth erect, sharp-pointed, approximated; hands palmated, with a membrane surrounding the body, and giving the animal the power of flight. Bats fly only by night, in quest of their food, consisting of gnats and moths, and when deprived of their eyes, appear to feel no want of them, having a supplemental power of perception, by which they avoid objects in the way with nearly as much precision as in their perfect state. In cold climates they pass the winter in torpor, assembling in holes and in caverns, in which they are occasionally seen adhering in great numbers to the walls, and sometimes suspended by their hind legs. The bones of the

enabled to unfold optionally, for flight, or to withdraw into a very small compass, when they wish to repose. The general division is into those which have tails, and those which have none. There are twenty-five species. The common bat is well known, the most remarkable of the species is the vespertilio vampyrus, or vampyre bat.

This remarkable animal is an inhabitant of India and South America, is about twelve inches long, and the extent of its wings is four feet, and in some extraordinary instances, it is said, six. Its tongue is pointed, and terminated by sharp prickles. It is reported to suck the blood of cattle, by inserting the point of its tongue into one of their veins during sleep, so as to excite little or no pain. This is said to be done by them with respect to men also. Various writers, of general respectability, concur in these statements, and have observed, that in some parts of South America, and in India, it is on this account highly dangerous to sleep in the open air, or in apartments with open windows. This property of sucking the blood of human beings has long been affirmed of the bats of Europe; but though assertions of this nature are incapable of being contradicted, there does not appear to be any detail of well authenticated facts in their support. The two last species have no tail.

VESTIBULE, in architecture, a kind of entrance into a large building; being a place before the hall, or at the bottom of the staircase

VESTRY, a place adjoining to a church where the vestments of the minister are kept; also a meeting at such place where the minister, churchwarden, and principal men of most parishes, at this day make a parish vestry.

VESUVIAN, a mineral found in lava, especially at Vesuvius, and formerly confounded with hyacinth. Its colour is brown or greenish. It is found in masses, but usually crystalized in rectangular eight-sided prisms The primitive form of its crystal is the cube. The specific gravity is from 3. 39. to 3. 4.

VETERINARY ART; or FARRIERY, according to the modern acceptation of the term, comprehends the medical treatment of the horse. The first object that comes under notice is the mechanical operation of shoeing.

Shoeing of horses.—The shoes should be made three times as thick at the toe as at the heels, so that by this means the frog may come down to the ground. The nails are all placed forward, four on each side, but not approaching too near the heels. They should be counter sunk in conical or wedge-shaped holes. For horses which go in shafts, or are used in hunting, it is usual to make shoes with only one heel, which should be outward. The horse's heel must be rather lowered on that side, and the inner heel of the shoe somewhat thickened so as to balance and bear equally. The best breadth

for the shoe of a medium-sized horse is said to be one inch at the toe, and three quarters at the heel; the weight about eighteen or twenty ounces. In order to fit the shoe without causing the horse to stand too much on his heels, the under part of the crust, or wall of the hoof, is pared away to receive the excess of thickness in front; for the bottom of the shoe ought to be perfectly flat, without any stubs or calkings in front. Paring away the heels is a most destructive practice, except in case of absolute excrescence in those parts; nor should the bars, (or diagonal ridges) that extend from the heels to the frog, or central projection, ever be cut more than is absolutely proper for the purpose of keeping them in a clean and healthy state. A good open heel is the indication of a powerful foot; hence the sides of shoes ought not to be much contracted. When the heels are tender, what is called a bar-shoe ought to be applied. On the frog the horse chiefly depends for a spring, or resistance, at the bottom of his foot. If this part does not touch the ground, the whole motion will be derived from the upper parts of the limbs and a very uneasy gait will inevitably follow. This points out the necessity for leaving it fully at liberty to come in contact with the ground.

Teeth and age of horses.—The horse has 24 grinders, four tushes or single teeth, and twelve front teeth or gatherers. Mares in general have no tushes. The black mark or cavities denoting the age are to be found in the corner front teeth, adjoining the tushes. At four years and a half old, the mark teeth are just visible above the gum, and the cavity is very conspicuous. At five, the remaining colt's-teeth are shed, and the tushes appear. At six, the tushes are up, and appear white, small, and sharp; near which is observable a small circle of young growing flesh. The horse's mouth is then complete, the corner teeth being filled up. At eight the black marks disappear.

DISEASES.

Horses are subject to various diseases. *Anarsarca*, or dropsy of the skin, generally called the *water farcy*, is known by pits remaining after the skin has been pressed by the finger. The cure is effected by stimulant applications and by diuretics; smart friction and gentle exercise and nourishing food are highly serviceable. When only the lower extremities are diseased, rollers dipt in spirits or in oil of turpentine, will generally remove the complaint.

In *Ascites*, or dropsy of the belly, every means should be used for strengthening and accelerating the secretion in general. Drastic purges, diuretics, sweating, and, in some cases, mercury, seldom fail to render important service.

Bleeding should be performed with a lancet of a suitable size; the fleam being very uncertain and dangerous. The jugular vein is usually opened. A piece of thin cord should be passed round the horse's neck a little above the withers, and the part be wetted, so as to shew the vein. The quantity must depend on the case; but one or two quarts for periodical bleeding are enough to be drawn from a full-sized horse in good condition. When the bleeding is to be stopped, slacken the line, and pass a pin through the lips of the orifice; then with a few hairs, or a piece of thread, pass over the head and point of the pin, in an alternate (i. e. a figure of 8) direction, and make fast.

Breaking-down, proceeds from a rupture of the suspensory ligaments. The fetlock nearly touches the ground, but the foot can be bent when raised. Few cures are made, though much palliation may be effected by reducing the inflammation.

Broken wind, is supposed to proceed from a rupture of the cells in the lungs. The following are among the most frequent causes, viz. catarrhs, working after a full meal, or after drinking freely; girting too tight; being suddenly put into hot stables after standing out in a cold air, &c. &c. The food should be compact and nutritious, such as corn and old hay. Carrots are excellent in this case, as are parsnips and beet roots. The exercise ought to be regular; but never beyond a walking pace.

Canker, is a sharp humour, called the thrush, which in some instances, attacks the sole of the foot, rising like a fungous excrescence, covering the diseased part. Cut away freely from the horny sole, and dress the surface with tow dipped in a solution of lunar caustic.

Catarrh, often called *morfoundering*, is usually the effect of cold. If acute fever attends it, the greatest service will be rendered by warm diluting drinks, or by mild purges, aided by bleeding. The stable ought not to be kept too hot, as it would render the horse tender in his lungs. Encourage the running at the nose.

Corns, consist of extravasated blood or lymph, collected between the crust or wall of the hoof and the bars. Cut away as far as the extravasation, and apply a pledget of lint, dipped in tincture of myrrh, or in balsam of Peru: then turn the horse out to grass without shoes, or let a chambered shoe be put on, so as to avoid pressing the part.

Cough. The following has proved serviceable in chronic cough: Tar eight pounds, lime twelve pounds, water six gallons, mixed. Give a quart every morning.

Cracks in the heels proceed from a gross habit, filth, or washing the legs without rubbing them dry. Wash with strong soap suds, lower the food, give mild purges, or diuretics, and if the habit be full, bleed freely.

Diabetes, or a profuse discharge of urine, is generally incurable. It is often brought on by violent diuretics. Bad food is also a frequent cause. Opium, bark, and other tonics, will give relief.

Diarrhœa is sometimes critical; in which instance it should not be checked, but treated, with copious diluents: when induced by hard labour, with bad stabling, or bad food, it is to be treated with great caution; lest it should degenerate into dysentery inject the anodyne clyster, and give twice daily, opium two drachms, ipecacuanha three drachms, prepared chalk four ounces, thin starch a pint. If it does not answer the intention within four days, give alum whey, and encourage sweat by means of good clothing. Litter well, and allow a moderate current of air if the stable be hot.

Dysentery, commonly called *moltengrease*, is a most dangerous complaint. The animal is usually afflicted with tenesmus, and voids a great quantity of slimy mucus. The safest

purge, in the first stage, is about a quart of castor oil. If that does not remove the fæces, give calomel four drachms, gum arabic two drachms, with honey enough to form a bolus. ample clysters of gruel, linseed, water, &c. should be frequently injected. In obstinate cases administer the following: take ten poppy-heads, boil them in six quarts of water till only a gallon be left, and starch enough to soften into a thin mucilage, throw up three or four times daily. Internally the following may answer: Opium two drachms, ipecacuanha four drachms, nux vomica, in powder, one drachm, port wine one quart. Mix and repeat morning and evening. Let the horse be well clothed, so as to keep his skin moist; the stable should not be hot. If the dung smells offensively the stable must be fumigated and kept extremely clean.

Farcy is easily removed when it consists of merely a superficial inflammation, by burning the bud or swelling with a hot iron, or by caustic; but when the blood is infected, (which is known by the buds being ulcerated and a discharge at the nose,) a scruple of corrosive sublimate, levigated, mixed with butter, or in gruel, must be given in two doses, i. e. night and morning. If the sublimate should prove too powerful, substitute a drachm of calomel, night and morning. Green food is peculiarly serviceable. Destroy the clothing after a cure, or the disease will be regenerated.

Fever. If the common inflammatory symptoms are indicated by the pulse, the eyes, and the general action of the horse, bleeding, emetics, and glyster, are necessary. Avoid whatever is heating; let the animal be kept in a cold stable, and clothed moderately. Let him have plenty of warm drink of a diluent kind. When a fever is symptomatic, the cause must first be removed; in the meanwhile soothing palliating treatment should be resorted to. When the fever is of a malignant species, and the horse is in a robust state, bleed copiously: but if emaciated, or of a weak frame, avoid that evacuation. Wash the body with warm vinegar, in which aromatic herbs have been boiled: remove the dung instantly, and change the bedding twice or thrice within the day. Burn nitre every half hour, so as to occasion a thick smoke, and let a piece of touchpaper be always smothering in a corner of the stable, which ought to be very cool. Keep the body open with antiseptic purges, and use little clothing. Encourage every sore which may appear, and open rowels. This complaint being highly infectious, no other horses or horned cattle, should be allowed to stand within the same area.

Fistulous withers, are very troublesome complaints. Great cleanliness is necessary; and the part should be laid open, if the situation may admit: or, at all events, that a seton should be passed through the bottom of the sore, whence the matter might be discharged. Keep the body open, and let the diet be soft and cooling; allow free ventilation, and approach the animal gently.

Founder, is an affection of the feet. When all the feet are affected the horse lies down, and is unwilling, and perhaps unable to rise. The complaint requires very copious bleeding, and ease and rest. The shoes ought to be taken off, and very soft litter be allowed. Bleeding at the toes rarely fails of giving great relief endeavour to prevent the collection of matter. Purge well, and keep the feet cool by the frequent application of salt and water, or sugar of lead in water, or sal-ammoniac and vinegar. Pare away the crust, so as to liberate the foot from its usual constriction. When recovering, turn the animal out into a rich soft paddock, if the season permits; or into a soft straw yard. Allow no corn, unless when the horse is extremely weak; and then scalded malt, &c will answer best.

Grease. If it proceed from redundancy, bleed, purge, and use gentle exercise, with moderate friction. When from weakness, or over-labour allow rest and nourishing food, giving good standing, and preserving perfect cleanliness.

Gripes, have remissions of pain, which distinguish them from inflammation in the bowels, as does the disposition to roll on the back. Rake well, throw up clysters as warm as can be borne, and in large quantities. If the pain be very acute and obstinate, bleed copiously, and give a lump of opium, about the size of a large hazel-nut. But this must be done before any symptoms of inflammation appear. Foment the bowels with hot water by means of blankets. Give a draught of castor-oil, one pint; oil of peppermint, one drachm; mix them with the yolks of two eggs, and add a pint of water. If the bowels have not been well opened, give calomel, half an ounce; gumgamboge, one drachm; Castile soap, half an ounce; made into bolus, with honey, and given at night; keeping on warm clothing, and cautiously avoiding a draught of wind.

Hepatitis, may be known by a yellowness of the eyes and mouth, attended with considerable fever. Bleed freely, and blister the sides, applying numerous rowels underneath. Rake and clyster; then purge well, by giving the following bolus night and morning, till it operates freely. Calomel, half a drachm; aloes, one drachm and a half; Castile soap, two drachms; mix with honey.

Inflammation, in whatever part is generally the index to blood-letting. But local inflammations which seem to be critical, and push forward to suppuration, should rather be encouraged than resolved; unless they settle upon some part endangering the life. When the *brain* is inflamed, the lancet must be freely used, as must the blistering ointment and purges. The *eye* must, when in a state of irritation be kept cool, and the habit lowered. Mild solutions of white vitriol, added to a few drops of extract of saturn, should be applied, in the form of poultice, cold and frequently. When the stomach is inflamed, bleed, and clyster with soft cooling liquors. In inflamed bladder avoid diuretics; administer clysters, and give mucilaginous, soothing drinks. When the kidneys are inflamed, the animal ought to be kept very low, after ample evacuations, both by bleeding and gentle purges.

Lampas, is a swelling of the bars in the roof of the mouth, chiefly in young horses. Rub the part with alum and honey; if they do not subside, you may scarify the part very slightly with a sharp instrument guarded with tow, &c. near its point, so that you cannot, in case of accident, do injury by making too deep a wound.

Lethargy, is occasioned by too great a determination of blood towards the head. Bleed freely, unless when the debility is great; open the body by active purges, rake, and clyster, and endeavour to excite perspiration. Give nitre three drachms; resin, three drachms; cream of tartar, three drachms; all finely powdered, and mixed with honey into a bolus: repeat every morning, until the discharge of urine is abundant.

Mange, commonly arises from filth, or from poorness of condition, and is extremely infectious. Wash well with soap-suds, and apply common brimstone, levigated, eight ounces; of alum and white vitriol, each five drachms; horse turpentine, three ounces; lard, half a pound; mix and rub frequently.

Pole evil, arises chiefly from the friction of the collar at the back of the ears, or other such cause: it often forms a tumour, which must be brought forward, unless by blistering, &c. the fluid can be removed. Take care to open below the abscess, else there will be danger of sinuses.

Stag-evil, or locked jaw, is often caused by sudden changes from heat to cold. The cure will chiefly depend on opium, the warm bath, and other antispasmodics. Sometimes the sudden application of cold water in great quantities has been serviceable.

Staggers, or *phrensy*, is a variety of lethargy; only that the pressure on the brain is extreme, and the animal rendered outrageous. To effect a cure, bleed copiously, from three to four quarts every eight hours, until the symptoms abate. Blister the head and neck with Spanish flies mixed in spirits of turpentine: rake well, and administer a strong clyster. Let the stables be very cool, and sprinkled with hot vinegar. Give a bolus composed of calomel two drachms; aloes six drachms, Castile soap two drachms, mixed with honey. Allow very little drink. In desperate cases sling the horse, and throw cold water over his head and neck.

Strangles. This disease usually begins with a fever, a cough, a running at the nose, and a swelling at the sub-maxillary glands. Repel, if possible, by copious bleedings, opening the body, exciting perspiration, and by gentle diuretics. Give, night and morning, nitre six drachms, cream of tartar six drachms, emetic tartar a drachm and a half, warm gruel one quart.

Swelled legs. Gentle exercise and friction will be found the safest and most effectual remedy.

Thrush or *running-thrush*, is a discharge from the sensible frog. The running ought to be dried, taking care to bring the frog into action, by lowering the heels gradually, and bearing upon it by means of a bunch of tow. Use as warm as it can be borne, a wash composed of tar two ounces, and six drachms of oil of vitriol. Gentle purges and mild diuretics will greatly aid towards a cure.

Ulcers require soft dressings, and their edges should be kept low, and free from callous matter. Dress often, and in case of a sinus be careful to have the vent downwards, so that the discharge may be free. If fungous flesh arise, or the edges become hard, touch with blue vitriol, or with lunar caustic, and alteratives must be given. When the wound cicatrizes, apply a little lard very gently to soften the skin; and if the flies are troublesome, mix a very small quantity of tobacco in the lard.

Warbles, from under the saddle, in consequence of unequal pressure. Perfect rest is the best remedy; but a solution of sugar of lead in vinegar will greatly promote dispersion. If they become firm, blister them, or fully extirpate by the knife.

Wind-galls must be removed by firm pressure on a bolster that immediately sits upon the swelling; when subdued, the part should be fired, to prevent recurrence of the complaint. The sweating blister, made by steeping Spanish flies in vinegar, often has a good effect.

Worms. When a horse rubs his tail, and a yellow matter appears at times about the anus, worms may be suspected. Common salt is one of the most powerful remedies; but subjects the horse to considerable inquietude. The root of the male fern, levigated, and given fresh, is highly extolled, as is soot also. Strong doses of calomel and gamboge will be found the most efficient, provided they be persevered in so as to scour for a number of days; but this must greatly depend on the condition and constitution of the horse.

VIBRATION, in mechanics, a regular reciprocal motion of a body, as a pendulum, &c. which, being freely suspended, swings or oscillates, first this way, then that.

VICAR, one who supplies the place of another. The priest of every parish is called rector, unless the prædial tithes are appropriated, and then he is styled vicar; and when rectories are appropriated, vicars are to supply the rector's place.

VICARAGE. For the most part vicarages were endowed upon appropriations; but sometimes vicarages have been endowed without any appropriation of the parsonage; and there are several churches where the tithes are wholly impropriated, and no vicarage endowed; and there the impropriators are bound to maintain curates to perform divine service, &c.

VICE, in smithery, and other arts employed in metal, is a machine or instrument, serving to hold fast any thing they are at work upon, whether it is to be filed, bent, rivetted, &c.

Vice, *hand*, is a small kind of vice serving to hold the lesser works, that require often turning about.

Vice, is also a machine used by the glaziers to turn or draw lead into flat rods, with grooves on each side to receive the edges of the glass.

VICINAGE. Common of vicinage is, where the inhabitants of two townships, which lie contiguous, have usually inter-commoned with one another, the beasts of the one straying mutually into the other's fields without any molestation from either.

VILLAIN, or *Villein*, in our ancient customs, denotes a man of servile and base condition, viz. a bondman or servant; and there were anciently two sorts of bondmen or villains in England: the one termed a villain in gross, who was immediately bound to the person of his lord and his heirs; the other a villain regardant to a manor, he being bound to his lord as a member belonging and annexed to the manor whereof the lord was owner.

VINE. See Vitis.

VINEGAR is a liquid of a reddish or yellowish colour, a pleasant sour taste, and an agreeable odour. Its specific gravity varies from 1.0135 to 1.0251, and it differs also in its other properties according to the liquid from which it has been procured. It is very subject to decomposition: but Scheele discovered that if it is made to boil for a few moments, it may be kept afterwards for a long time without alteration. Besides acetic acid and water, vinegar contains several other ingredients, such as mucilage, tartar, a colouring matter, and often also two or more vegetable acids. When distilled at a temperature not exceeding that of boiling water, till about two thirds of it have passed over, all these impurities are left behind, and the product is pure acid diluted with water.

VINEYARD, a plantation of vines.

VIOL, a stringed instrument resembling in shape and tone the violin, of which it was the origin; that impressive and commanding instrument being little more than an improvement of the old viol.

VIOLA, a tenor violin. This instrument is similar in its tone and formation to the violin, but its dimensions are somewhat greater, and its compass a fifth lower in the great scale of sounds.

Viola, a genus of plants of the class syngenesia, order monogynia; in the natural system arranged under the 29th order, campanaceæ. The calyx is pentaphyllous; the corolla five-petalled, irregular with a nectarium behind, horn-shaped: the capsule is above the germen, three-valved, monolocular, 43 species.

VIOLIN, or *Fiddle*, a well known stringed instrument of brilliant tone and active execution. The four strings of which it consists, are tuned in fifths from each other. The pitch of the lowest string is G, under the second ledger line in the treble stave; consequently that of the next is D, under the first line of the stave; the pitch of the next above that A on the second space; and that of the upper string, E on the fourth space.

VIOLONCELLO, a bass viol, containing four strings, the lowest of which is turned to double C. The strings are in fifths, consequently the pitch of that next the gravest is C gamut; that of the next, D on the third line in the bass; and that of the upper string, A on the fifth line.

VIPER. See Serpentes.

VIRGO, in astronomy, one of the signs or constellations of the zodiac, and the sixth according to order.

VITIS, a genus of the class pentandria, and order monogynia; and in the natural system arranged under the 46th order, pectoraceæ. The petals cohere at the top, and are withered; the fruit is a berry with five seeds. There are 12 species; the most important of which is the vinifera, or common vine, which has naked, lobed, sinuated leaves. There are a great many varieties; but a recital of their names would be tiresome without being useful. All the sorts are propagated either from layers or cuttings; the former of which methods is greatly practised in England, but the latter is much preferable.

VITRIOL, *martial* or *sulphat of iron*. In commerce it is usually denominated green vitriol or copperas. It is not prepared by dissolving iron in sulphuric acid, but by moistening the pyrites which are found native in abundance, and exposing them to the open air. They are slowly covered with a crust of sulphat of iron, which is dissolved in water, and afterwards obtained in crystals by evaporation. Sometimes the salt is found ready-formed, either in a state of solution in water, or mixed with decayed pyrites. In some cases it is found necessary to roast the pyrites before they can be made to undergo spontaneous decomposition. Sulphat of iron has a fine green colour. Its crystals are transparent rhomboidal prisms, the faces of which are rhombs with angles of 79 deg. 50 min. and 100 deg. 10 min. inclined to each other at angles of 98 deg. 37 min. and 81 deg. 23 min. It has a very strong styptic taste, and always reddens vegetable blues. Its specific gravity is 1.8399. It is soluble in about two parts of cold water, and in $\frac{3}{4}$ths of its weight of boiling water. It is insoluble in alcohol.

VITUS'S DANCE. See Medicine.

VIVERRA, a genus of quadrupeds of the order of feræ. The generic character is, cutting-teeth six, sharpish; canine teeth longer; tongue in some smooth, in others aculeated backward; body of a lengthened form. This genus comprehends all the animals of the weasel kind, which seem to be somewhat unnecessarily separated by Linnæus into two distinct genera, under the titles viverra and mustela; in which latter genus the otters are also included. There are forty-five species, of which the following are principally deserving of notice.

Viverra, *ichneumon*, or the ichneumon, of which there are two varieties, the Indian and the Egyptian. The Egyptian ichneumon is nearly three feet and a half in full length, and of a pale reddish grey colour. It bears a mortal enmity to rats, and snakes, and other offensive animals, with which Egypt is infested, and is domesticated frequently in that country for the sake of its services on this account.

Viverra, *striata*, is a native of Mexico, and discriminated by five longitudinal stripes of white on its back of chocolate colour. When irritated by fear or anger it emits a vapour extremely fetid, in comparison with which every other odour, generally deemed repulsive and disgusting, is pronounced to be the most exquisite perfume.

Viverra, *civetta*, or the civet, is a native of the warm territories of Asia and Africa, and above two feet long, exclusively of the tail. It subsists on smaller quadrupeds and birds. This animal is distinguished for its perfume, for which it was well known to the ancients, who considered it as one of the most powerful stimuli, and for which it is kept in a state of confinement in Holland at the present day, as well as in the East. The drug produced by the civets is formed in a glandular receptacle, and is taken from it by its keeper several times in the course of a week; the quantity generally procured from each civet at a time being about a drachm, but varying with the state of the animal's health, and the nourishing quality of its food.

Vivera, *furor*, or the ferret, resembles the pole-cat both in form and manners. It is a native of Africa, whence it is stated to have

been imported into Spain for the destruction of the rabbits, which had multiplied in that country to the most injurious excess. It was thence introduced into other European countries, but is ill adapted to endure the rigours of a northern winter, being particularly susceptible of cold.

Viverra, *vulgaris*, or the common weasel, is about nine inches long, including the tail, is elegant in its appearance, and light in its movements, but unpleasant by the odour which accompanies it. It dwells under the roots of trees, and subsists on field mice, small birds, and even young rabbits. It is also particularly fond of eggs. It is often fatal to the hare itself, which appears to entertain for the weasel extreme terror, and to be overwhelmed at the sight of it into a complete incapacity for resistance. It is a more formidable enemy to rats and mice than even the cat itself, as it has greater facility for pursuing them to their retreats, and on this account it is much valued and encouraged by the farmer. Its bite is said to be almost certainly, though not always immediately fatal.

VIVIPAROUS, in natural history, an epithet applied to such animals as bring forth their young alive and perfect, in contradistinction to them that lay eggs, which are called oviparous animals.

ULLAGE, in gauging, is so much of a cask, or other vessel, as it wants of being full. See Gauging.

ULMUS, a genus of plants of the class pentandria, and order digynia, and in the natural system arranged under the 53d order, scabridæ. There are six species, two of which are natives of Britain, viz. the campestris, common elm, and the montana, or wych elm. All the sorts of elm may be either propagated by layers or suckers taken from the roots of the old trees, the latter of which is generally practised by the nursery gardeners. The elm delights in a stiff, strong soil. It is observable, however, that here it grows comparatively slow. In light land, especially if it is rich, its growth is very rapid; but its wood is light, porous, and of little value, compared with that which grows upon strong land, which is of a closer, stronger texture, and at the heart will have the colour, and almost the heaviness and the hardness, of iron. On such soils the elm becomes profitable, and is one of the trees which ought, in preference to all others, to engage the planter's attention.

ULVA, a genus of plants of the class cryptogamia, and order of algæ. The fructification is inclosed in a diaphanous membrane. There are 26 species of British plants. They are all sessile, and without roots, and grow in ditches, and on stones along the sea-coast.

UMBELLIFEROUS PLANTS, are such as have their tops branched and spread out like an umbrella, on each little subdivision of which there is growing a small flower; such are fennel, dill, &c.

UMBER, or Umbre, *umbria*, among painters, &c. a kind of dry dusky-coloured earth, which, diluted with water, serves to make a dark brown colour, usually called with us a hair colour.

UNCIA, in general, a Latin term denoting the twelfth part of any thing, particularly the twelfth part of a pound, called in English an ounce; or the twelfth part of a foot, called an inch.

UNCIÆ, in algebra, the numbers prefixed before the letters of the members of any power produced from a binomial, residual, or multinomial root. Thus, in the fourth power of $a + b$, viz. $a^4 + 4a^3b + 6a^2b^2 + 4ab^3 + b^4$, the unciæ are 4, 6, and 4, being the same with what others call co-efficients.

UNDULATION, in physics, a kind of tremulous motion or vibration observable in a liquid, whereby it alternately rises and falls like the waves of the sea. Thus undulatory motion, if the liquid be smooth and at rest, is propagated in concentric circles, as most people have observed upon throwing a stone, or other matter, upon the surface of a stagnant water, or even upon touching the surface of the water lightly with the finger, or the like.

UNGULA, in geometry, the section of a cylinder cut off by a plane passing obliquely through the plane of the base and part of the cylindric surface.

UNITARIANS, in church history, are those who believe that there is but one God, the supreme object of religious worship; and that this God is the Father only, and not a Trinity consisting of Father, Son, and Holy Ghost. The prime article in the system of this religious body is, that Jesus Christ was a mere man, and that therefore worship addressed to him is idolatry.

UNIVALVE *shells*, in natural history, a term used to express one of the three general classes of shell-fish; the other two being the bivalves and multivalves.

UNIVERSALISTS, those who hold that all future punishment is designed for correction; and that, consequently, all rational beings will be ultimately rendered happy by the God of love and mercy.

UNIVERSITY. This term signifies the establishment of many colleges in one particular situation, all of which are subject to the same general government, and which are formed by the residence of numerous professors in every branch of science, who teach them to students assembled from all parts of Europe, and particularly the countries possessing those seats of learning.

VOLCANO, in natural history, a burning mountain, or one that occasionally vomits forth fire, flame, ashes, cinders, &c. Volcanoes are peculiar to no climate, and have no necessary connection with any other mountains, but seem to have some with the sea, being generally in its neighbourhood; they frequently throw out matters which belong to the sea, as the relics of fishes, sea-weed, and sometimes sea-water itself. The most celebrated volcanoes are those of Ætna and Vesuvius.

The combustion of those enormous masses of bitumen, which are deposited in the bowels of the earth, produces volcanoes. They owe their origin more especially to the strata of pyritous coal. The decomposition or action of water upon the pyrites determines the heat, and the production of a great quantity of hydrogen, which exerts itself against the surrounding obstacles, and at length breaks them. This effect appears to be the chief cause of earthquakes; but when the concourse of air facilitates the combustion of the bitumen and the hydrogen, the flame is seen to issue out of the chimneys or vents which are made: and this occasions the fire of volcanoes.

As volcanoes exist in our earth, there is every

reason to believe that they exist also in other earths. An appearance of this kind was discovered some years ago by Don Ulloa in an eclipse of the sun. It was a small bright spot, like a star, near the margin of the moon, and which he at that time supposed to have been a hole, with the sun's light shining through it. Succeeding observations, however, have induced astronomers to attribute appearances of this kind to the eruption of volcanic fire; and Dr. Herschel has particularly observed several eruptions of the lunar volcanoes, the last of which he gives an account of in the Philosophical Transactions for 1787.

VOLVOX, in zoology, a genus of animals belonging to the order of vermes infusoria. The body is round, simple, and pellucid. There are ten species, all of which live in water.

VOLUTA, in natural history, a genus of animals belonging to the class and order of vermes testacea. There are 144 species.

VOLUTE, a spiral scroll, used in the Ionic and Composite capitals, whereof it makes the principal characteristic and ornament. See Architecture.

VOMITING. See Medicine.

VORTEX, in the Cartesian philosophy, is a system or collection of particles of matter moving the same way, and round the same axis.

VORTICELLA, a genus of vermes infusoria. The generic character is, body contractile, naked, and furnished with ciliate rotatory organs. There are nearly sixty species of this genus.

VOWEL, in grammar, a letter which affords a complete sound of itself, or a letter so simple as only to need a bare opening of the mouth to make it heard, and to form a distinct voice. See Grammar.

The vowels are six in number, viz. A, E, I, O, U, Y, and are called vowels in contradistinction to certain other letters, which depending on a particular application of some part of the mouth, as the teeth, lips, or palate, can make no perfect sound without [illegible] opening of the mouth, that is, without the addition of a vowel, and are therefore called consonants.

UPUPA, in ornithology, a genus belonging to the order of picæ. The beak is arcuated, convex, and something blunt; the tongue is obtuse, triangular, entire, and very short; and the feet are fitted for walking. There are ten species, one of which, the epops, hoopoe, or dung-bird, is frequently seen in Britain.

URANAIUM. See Chemistry.

URANOSCOPUS, star-gazer, a genus of fishes of the order jugulares. The generic character is, head large, depressed, rough; mouth furnished with an internal cirrus; gill-covers edged by a ciliated border gill-membrane five-rayed. There are only two species.

UREA, the constituent and characteristic matter of urine, may be obtained by the following process:—Evaporate by a gentle heat a quantity of human urine, voided six or eight hours after a meal, till it is reduced to the consistence of a thick syrup. In this state, when put by to cool, it concretes into a crystalline mass. Pour at different times upon this mass four times its weight of alcohol, and apply a gentle heat; a great part of the mass will be dissolved, and there will remain only a number of saline substances. Pour the alcohol solution into a retort, and distil by the heat of a sand-bath till the liquid, after boiling some time, is reduced to the consistence of a thick syrup. The whole of the alcohol is now separated, and what remains in the retort crystallizes as it cools. These crystals consist of the substance known by the name of urea.

URIC *acid*. This acid was discovered by Scheele in the year 1776. It was at first called lithic acid. It constitutes one of the component parts of urinary calculi, and is also found in human urine. There is one species of calculus which is almost entirely composed of this substance; it is that species which resembles wood in appearance and colour. This acid is insipid, inodorous, almost insoluble in cold water, and soluble only in about 360 parts of boiling water.

URINE. This excrementitious fluid, in its natural state, is transparent, of a yellow colour, a peculiar smell, and saline taste. Its production, as to quantity, and in some measure quality, depends on the seasons, and the peculiar constitution of the individual, and likewise modified by disease. It is observed, that perspiration carries off more or less of the fluid, which would else have passed off by urine; so that the profusion of the former is attended with a diminution of the latter.

From the alkaline smell of urine kept for a certain time, and other circumstances, it was formerly supposed to be an alkaline fluid; but by its reddening paper stained blue with litmus or the juice of radishes, it appears to contain an excess of acid.

Urine soon undergoes spontaneous changes, which are more or less speedy and extensive, according to its state, as well as the temperature of the air. Its smell, when fresh made, and healthy, is somewhat fragrant; but this presently goes off, and is succeeded by a peculiar odour termed urinous. As it begins to be decomposed, its smell is not very unlike that of sour milk; but this soon changes to a fetid, alkaline odour. It must be observed, however, that, turpentine, asparagus, and many other vegetable substances, taken as medicine, or used as food, have a very powerful effect on the smell of the urine. Its tendency to putrefaction depends almost wholly on the quantity of gelatin and albumen it contains; in many cases, where these are abundant, it comes on very quickly indeed.

Urine has been employed for making phosphorus, volatile alkali, and sal ammoniac; moulds to the produce of nitre beds; and it is very useful in a putrid state for scouring woollens.

URSA, the *bear*, in astronomy, a name common to two constellations of the northern hemisphere, near the pole, distinguished by major and minor.

URSUS, *bear*, a genus of quadrupeds of the order feræ: the generic character is, front teeth six both above and below: the two lateral ones of the lower jaw longer than the rest, and lobed; with smaller or secondary teeth at their internal bases; canine teeth solitary; grinders five or six on each side, the first approximated to the canine teeth; tongue smooth; snout prominent; eyes furnished with a nictitating membrane. There are ten species.

Ursus, *arctus*, the brown bear, is met with in almost all the northern territories of Europe and Asia, and lives solitary in remote forests,

subsisting principally on fruits and other vegetable substances, and occasionally devouring animals. It is particularly fond of honey, and is said to possess great sagacity in discovering it; and will ascend high trees to obtain it. It frequently resides in the hollows of trees, and sometimes fixes its habitation in the banks of rivers, for the sake of fish, which it sometimes takes and devours. Towards the close of autumn, it retires to its habitation in a state highly fleshy and fat, and remains for weeks together without food, and almost without motion.

Ursus *Americanus*, or the American bear, has a long pointed nose, and is generally smaller than the above species. It abounds in the northern territories of America, and is said to live exclusively on vegetable food, extreme hunger only being able to induce it to eat the flesh of animals. These bears reside in trees, mounting and descending them with great alertness. Their skins form an important article of merchandize; their flesh, when young, is thought delicious; and their fat is thought an admirable application for sprains and bruises. They are taken frequently by setting fire to the trees which they inhabit.

Ursus *maritimus*, or the Polar bear, is nearly double the size of the common bear, and is stated to have been seen of the length of twelve feet. It is completely white. Its principal residence is on the shores of Greenland and Hudson's Bay, and it inhabits only the coldest regions of the world. It possesses the most formidable strength and ferocity. They subsist on fishes, seals, and whales, at sea; and by land devour birds, hares, deer, and various other animals; and will also eat berries and various other vegetables. In Greenland they sometimes surround the habitations of the natives, allured by the strong smell of the seal oil, and attempt to break through to commit their depredations; but are reported to be effectually repelled by the smell of burnt feathers. In winter they ingulph themselves in the snow, or immure themselves in some cavern, where they pass in torpor the Polar night, making their egress only with the re-appearance of the sun: in summer they are often found on large masses of floating ice at sea, and, swimming with great excellence, they pass from one of these to another with much facility.

Ursus *meles*, the badger, is an inhabitant of all the temperate parts of Europe and Asia. Its usual length is about two feet from the nose to the tail, which measures six inches. It is an animal of very clumsy make, being thick-necked and thick-bodied, with very short legs. It commonly resides in a hole or den under ground, out of which it emerges by night in quest of food; feeding chiefly on roots and fruits; but it will also devour frogs, worms, &c.

URTICA, a genus of plants of the class monoecia, and order tetrandria; and in the natural system classed under the 53d order, scabridæ. The male flower has a calyx of four leaves; no corolla; a nectarium minute, central, urn-fashioned. The female a bivalve calyx; and a single, oval, glossy seed. There are 59 species, three of which are British plants.

Nettle-tops in the spring are often boiled and eaten by the common people instead of cabbage-greens. In Arran, and other islands, a rennet is made of a strong decoction of nettles: a quart of salt is put to three pints of the decoction, and bottled up for use.

USANCE, in commerce, is a determinate time fixed for the payment of bills of exchange, reckoned either from the day of the bills being accepted, or from the day of their date; and thus called because regulated by the usage and custom of the places whereon they are drawn.

USHER, an officer, or servant, who has the care and direction of the door of a court, hall, chamber, or the like.

Usher *of the Black Rod*, the eldest of the gentlemen-ushers daily waiters at court, whose duty is to bear the rod before the king at the feast of St. George, and other solemnities: he has also the keeping of the chapter-house door, when a chapter of the order of the garter is sitting, and in time of parliament attends the house of peers, and takes delinquents into custody. He wears a gold badge, embellished with the ensigns of the order of the garter.

USURY, in a strict sense, is a contract upon the loan of money, to give the lender a certain profit for the use of it, upon all events, whether the borrower made any advantage of it, or the lender suffered any prejudice for the want of it, or whether it be repaid at the appointed time or not; and in a large sense, it seems, that all undue advantages taken by a lender against a borrower, come under the notion of usury.

VULGATE, a very ancient Latin translation of the bible, and the only one the church of Rome acknowledges authentic. See Bible. The ancient vulgate of the old testament was translated almost word for word from the Greek of the LXX. The author of the version is not known, nor so much as guessed at.

Vulgate *of the New Testament*. This the Romanists generally hold preferable to the common Greek text, in regard it is this alone, and not the Greek text, that the council of Trent had declared authentic. Accordingly that church has, as it were, adopted this edition. The priests read no other at the altar, the preachers quote no other in the pulpit, nor the divines in the schools.

VULTUR, the *vulture*, in natural history, a genus of birds belonging to the order of accipitres. The beak is straight, and crooked at the point; the head has no feathers, on the forepart there being only naked skin, and the tongue is generally bifid. There are twenty-one species. The most remarkable are,

Vultur gryphus, or the condor vulture, is found particularly in South America, and from point to point of its wings is of the width of twelve feet. The feathers of its back are of a brilliant black. Its quill feathers are more than two feet and a quarter in length, and are half an inch in diameter.

Vultur harpya, or the crested vulture, is rather larger than a turkey, and is distinguished by a crest of four feathers on its head. Its strength is extraordinary, and with a single stroke of its bill it is reported to be able to cleave down the skull of a man. It is found in Mexico and Brazil.

Vultur aura, or the carrion vulture, is of the same size as the last, is common both in North and South America, and feeds on carcases and on snakes. Its odour is particularly rank. It is far from being ferocious and dangerous, may

be easily reared tame, and is considered in the West Indies as highly useful in destroying reptiles, vermin, and carrion, insomuch that the killing of them is prohibited by law. They roost together at nights in considerable numbers, in the manner of rooks.

Vultur sagittarius, or the secretary vulture, is distinguished by the extraordinary length of its legs, and when standing upright is a yard high. It is found in Africa, and in the Philippine Islands. It principally lives on lizards and rats, and various species of vermin. It strikes with its feet forwards, and never the contrary. It takes up tortoises in its claws, and dashes them with great force on the ground, and will repeat this process till these animals are completely killed.

UVULARIA, a genus of the hexandria monogynia class of plants, the flower of which consists of six very long lanceolated petals; and its fruit an ovate-oblong trilocular capsule, containing several roundish and compressed seeds. There are six species.

W.

W, or w, is the twenty-first letter of our alphabet, and is composed, as its name implies, of two v's. It was not in use among the Hebrews, Greeks, or Romans, but chiefly peculiar to the northern nations, the Teutones, Saxons, Britons, &c.

WACHENDORFIA, a genus of plants of the class triandria, and order monogynia; and arranged in Linnæus's natural method of classification under the 6th order, ensatæ. The corolla is hexapetalous, unequal, and situated below the germen; the capsule trilocular and superior. There are five species, none of which are natives of Britain.

WACKE, a mineral substance intermediate between clay and basalt. It is sometimes simple; but when it inclines to basalt, it contains hornblende and mica. It is sometimes spotted, and these spots are unformed crystals of hornblende, resembling the unformed crystals of felspar in certain varieties of porphyry. It never contains augite or olivine. When it approaches to an amygdaloid, it is vesicular. Its colour is greenish-grey. Massive and vesicular. Dull. Opaque. Streak shining. Soft. Easily frangible. Specific gravity 2.55 to 2.9. Fuses like basalt.

WADD, or WADDING, is a stopple of paper, hay, straw, or the like, forced into a gun upon the powder to keep it close in the chamber; or to put up close to the shot to keep it from rolling out.

WADD. This name is given to plumbago, or black-lead.

WADD, *black*. An ore of manganese found in Derbyshire. It is remarkable for the property of taking fire when mixed with linseed oil.

WAFERS are made thus: take very fine flour, mix it with glair of eggs, isinglass, and a little yeast; mingle the materials; beat them well together, spread the batter, being made thin with gum water, on even tin plates, and dry them in a stove; then cut them out for use. You may make them of what colour you please, by tinging the paste with brazil or vermilion for red; indigo or verditer, &c. for blue; saffron, turmeric, or gamboge, &c. for yellow.

WAGER of law is a particular mode of proceeding, whereby, in an action of debt, brought upon a simple contract between the parties, without any deed or record, the defendant may discharge himself by swearing in court, in the presence of compurgators, that he owes the plaintiff nothing, in manner and form as he has declared, and his compurgators swear, that they believe what he says is true. And this waging his law is sometimes called making his law. It being at length considered, that this waging of law offered too great a temptation to perjury, by degrees new remedies were devised, and new forms of action introduced, wherein no defendant is at liberty to wage his law, as in assumpsit and trover.

WAGERS. In general a wager may be considered as legal, if it is not an incitement to a breach of the peace, or to immorality; or if it does not affect the feelings or interest of a third person, or expose him to ridicule: or if it is not against sound policy.

WAGES, what is agreed upon by a master to be paid to a servant, or any other person that he hires to do his business for him.

WAGTAIL, in ornithology. See MOTACILLA.

WAIFS. See ESTRAYS.

WAKE *of a ship*, is the smooth water astern when she is under sail. This shows the way she has gone in the sea, whereby the mariners judge what way she makes. For if the wake be right a-stern, they conclude she makes her way forwards; but if the wake be to leeward a point or two, then they conclude she falls to the leeward of her course.

WALE, or WALES, in a ship, those outermost timbers in a ship's side on which the sailors set their feet in climbing up. They are reckoned from the water, and are called her first, second, and third wale, or bend.

WALRUS. See TRICHECHUS.

WALNUT-*tree*. See JUGLANS.

WALTHERIA, a genus of the monadelphia pentandria class of plants, the flower of which consists of five petals, vertically cordated and patent; the fruit is an unilocular bivalve capsule, vertically ovated; and the seed is single, obtuse, and broadest at the top. There are six species.

WAPENTAKE, from the Saxon, the same with what we call a hundred, and more especially used in the northern counties beyond the river Trent.

WAR. The too frequent recurrence of this great and detestable calamity, unfortunately renders a definition of the word unnecessary. If we were called upon to define it, we should say, it is the wanton destruction, the cold-blooded slaughter, of the human race: we should call it an accumulation of every sin that degrades and vilifies mankind: we should mark it as a practice that diffuses misery and

perpetuates vice: we should say, that if there is a burlesque upon the boasted reason of man, it is this; when millions meet to murder each other for a quarrel in which, in general, they have not individually the smallest interest. The poet who wrote,

> "One murder makes a villain, millions a hero," &c.

deserves a statue of gold; and the writer of that verse may lift his head in the proudest assembly, and avow his principles in the face of the world.

WARD, in law-books, a word of divers significations; thus, a ward in London, is a part of the city committed to the special charge of one of the aldermen of the city.

WARDEN, one who has the charge or keeping of any person, or thing, by office. Such is the warden of the Fleet, the keeper of the Fleet-prison; who has the charge of the prisoners there, especially such as are committed from the court of chancery for contempt.

WARDMOTE, in London, is a court so called which is kept in every ward of the city, answering to the curiata comitia in ancient Rome.

WARNING WHEEL, in a clock, is the third or fourth, according to its distance from the first wheel. See CLOCK-WORK.

WARP, in the manufactures, is the threads, whether of silk, wool, linen, hemp, &c. that are extended lengthwise on the weaver's loom; and across which the workman by means of his shuttle passes the threads of the woof, to form a cloth, ribband, fustian, or other stuff.

WARRANT, a præcipe, under hand and seal, to some officer, to bring any offender before the person granting it; and warrants of commitment are issued by the privy council, a secretary of state, or justice of peace, &c. where there has been a private information, or a witness has deposed against an offender. Any one under the degree of nobility may be arrested for a misdemeanor, or any thing done against the peace of the kingdom, by warrant from a justice of the peace; though if the person be a peer of the realm, he must be apprehended for a breach of the peace by warrant out of the King's Bench.

WARRANT *of attorney*, is an authority and power given by a client to his attorney, to appear and plead for him; or to suffer judgment to pass against him by confessing the action, by nil dicit, non sum informatus, &c.

WARRANTY, a promise or covenant by deed, made by the bargainer, for himself and his heirs, to warrant or secure the bargainee and his heirs against all men, for the enjoying any thing agreed on between them.

WARREN, a franchise, or place privileged either by prescription or grant from the king, to keep beasts and fowl of warren in; as rabbits, hares, partridges, pheasants, &c.

WASH, among distillers, the fermentable liquor used by the malt distillers.

WASP. See VESPA.

WASTE, is the committing any spoil or destruction in houses, lands, &c. by tenants, to the damage of the heir, or of him in reversion or remainder; whereupon the writ or action of waste is brought for the recovery of the thing wasted, and damages for the waste done.

WATCH, in the art of war, a number of men posted at any passage, or a company of the guards who go on the patrol. At sea, the term denotes a space of four hours.

WATCH, strictly speaking, is a term denoting all such movements as shew the parts of time; and clocks are such as publish it, by striking a bell. But the name watch is commonly appropriated to such machines of this kind as are carried in the pocket; and clock to the larger movement whether they strike or not.

As nothing has been said on the construction of either of these machines, either under the article *clock*, or that of *horology*, a brief description of both shall now be given. By referring to the plates the reader will readily comprehend the nature of this beautiful and useful mechanism.

Fig. 1, Plate LI, exhibits a profile view of an eight-day clock, with repeating, striking mechanism. To this figure, and to figure 2, the letters are common; *a*, is the barrel of the going part, having a band of catgut *b* wound round it, and to which the weight which keeps the clock going, is suspended; 96 is a wheel, called the great, or first wheel, having that number of teeth, upon the end of the barrel, turning a pinion of eight leaves, on an arbour which carries the minute-hand. 64, is a wheel of 64 teeth on the same arbour, turning the wheel 60 by a pinion of eight leaves on its arbour; this gives motion to the pinion of eight, on the arbour of the swing wheel 30, of 30 teeth; *d, h*, are the pallets of the escapement fixed on an arbour *e*, fig. 1, going through the back plate of the clock's frame, and carrying a long lever *f*; this lever has a small pin projecting from its lower end, going into an oblong hole, made in the rod B of the pendulum. The pendulum consists of an inflexible metallic rod, suspended by a very slender piece of steel-spring, D, from a brass bar, E, screwed to the frame of the clock, having a weight at its lower end; when this pendulum is moved from the perpendicular line in either direction, and suffered to fall back again, it swings nearly as much beyond the perpendicular on the contrary side, and then returns; this it will continue to do for some time, and each of these vibrations will be performed in one second of time. This is the measurer of the time; and the office of the clock is only to indicate the number of vibrations it has made, and give it a small impulse each time to keep it going, as the resistance of the air and elasticity of the spring D would otherwise in a few hours cause it to stop. By the action of the weight applied to the cord *b*, the wheels are all turned round, and if the pallets *d, h* were removed, the swing wheel 30 would revolve with great velocity in the direction from 30 to *d*, until the weight reached the ground; the teeth of these pallets are so made that one of them always engages the wheel, and prevents it turning more than half a tooth at a time. The pinion of eight on its arbour is turned by a wheel of 60, which consequently will turn once in seven turns and a half of the other, or in seven minutes 30 seconds, or one-eighth of an hour; its pinion of eight is moved by a wheel of 64, or eight times itself, which will turn in one-eighth part of the time, this will be an hour; the arbour of this wheel therefore carries the minute hand of the clock. The great wheel of 96, being 12 times the number

of the pinion eight, will turn once in 12 hours, and the barrel *a* with it. The gut goes round 16 times, so that the clock will go eight days. The hour-hand of the clock is turned by the wheel-work shewn in fig. 3: on the end of the arbour of the centre-wheel 64 a tube is fitted, so as to go round with it by friction; this carries the minute hand, but if the clock should require correction, the hand may be slipped round without moving the wheels: this tube has a pinion of 40 teeth on its lower end, indicated by a dotted circle: this turns another wheel 40, of 40 teeth, which has a pinion of six teeth on its arbour, turning a wheel 72, of 72 teeth; the two wheels 40 will both turn in an hour; and 72 in 12 hours: the arbour of this wheel has the hour-hand. and is a tube going over the arbour of the minute-hand, so that the two hands are concentric.

The barrel *a* is fitted to an arbour coming through the plate of the clock, and. is filed square to put on a key to wind up the weight; the great wheel 96 is not fixed fast to the arbour, but has a click on it, which takes the teeth of a rachet wheel cut upon the barrel; so that the barrel may be turned in the direction to wind up the weight without the wheel; but by the descent of the weight, the wheels will be turned by the click.

Having now described the going part of the clock, it remains to describe the mechanism by which the hours are struck. 78, fig 2, is a great wheel of 78 teeth, with a barrel and click the same as 96; it turns a pinion of eight; 64 is a wheel on the same arbour, turning a pinion of eight on the arbour of the wheel *o* of 48, this turns another pinion of eight, and wheel *p* of 48, which turns a pinion of six, on the same arbour with a thin vane of metal, which is called the fly, and by the resistance of the air to its motion, regulates the velocity of the wheels. The wheel 64 has eight pins projecting from it, these raise the tail *n* of the hammer, as they revolve; the hammer is returned violently when the pins leave its tail, by a spring *m* pressing on the end of a pin put through its arbour, and strikes the bell, *l* is a short spring which the other end of the pin through the arbour touches, just before the hammer strikes the bell, its use is to lift the hammer off the bell the instant it has struck, that it may not stop the sound. The eighth pin in the wheel 64 must pass by the hammer tail 78 times in striking the 12 hours, $1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 + 10 + 11 + 12 = 78$, and as its pinion has eight leaves, each leaf of the pinion answers to a pin in the wheel 64; now as the great wheel has 78 teeth, it will turn once in 12 hours, the same as the other great wheel 96. In the wheel 64 eight of its teeth correspond to one of the pins for the hammer, and as the pinion of the wheel *o* has eight teeth, it will turn once for each stroke of the hammer. By the remaining wheels, one, *o* multiplying six, and the other, *p*, eight times, the fly will turn $6 \times 8 = 48$ times for one turn of $o =$ one stroke of the hammer. Fig. 3 is also mechanism relating to the striking part: *r* is a small pinion of one tooth, called the gathering pallet, on the arbour of wheel *o*, and consequently turns once for each stroke of the hammer, *s* is a segment of a large wheel which it turns, (called the rack): *t* is an arm attached to the rack, whose end rests against the spiral plate, V, called the snail; this is fixed on the tubular arbour before described, of the hour hand and wheel 72, and turns round with it once in twelve hours. The plate is divided into twelve equal angles, 30 degrees each, and as it turns each of these answers to an hour. The circular part of the rack *s* is cut into teeth each of which is of such a length, that every step upon the snail shall answer to one of them; *w* is a spring pressing against the tail of the rack, and acting to throw the arm of the rack against the snail; *g* is a click or hawk's bill, taking into the teeth of the rack, and holding it up in opposition to the spring *w*; *i k* is a three-armed detent, called the warning-piece, the arm *k* is bent at its end, and passes through a hole in the front plate of the clock, so as to catch a pin placed in one of the arms of the wheel *p*, fig. 2, and which describes the dotted circle in fig. 3, the other arm *i* stands so as to fall in the way of a pin in the wheel 40. The wheel 40, turns once in an hour, and consequently at the expiration of every hour the pin in it takes the end *i*, and moves it towards the spring near it, this depresses the end *k* until it falls in the circle of the motion of the pin in the wheel *p*, fig. 2, at the same time the short tail depresses one end of the hawk's bill, and raises the other *g*, so as to clear the teeth of the rack *s*; immediately the spring *w* throws the rack back, until the end of its tail *t* touches that part of the snail which is nearest it; when the rack falls back, the pin in it is moved clear of the gathering pallet *r*, and the wheels set at liberty; the maintaining power puts them in motion; but in a very short time before the hammer has struck, the pin in the wheel *p* falls against the end of *k* and stops the whole: this operation happens a few minutes before the clock strikes, and this noise of the wheels turning is called the warning; when the hour is expired, the wheel 40 has turned so far as to allow the end of *t* to slip over its pin, as in the figure: the small pin pressing against it raises the end *k* so as to be within the circle of the pin in the wheel *p*, fig. 2: every obstacle is now removed, and the wheels run on the pinion; the wheel 64 raises the hammer *r*, and it strikes on the bell, the gathering palate *r*, and takes up the rack, a tooth at each turn, the hawk's bill *g* retaining it until the pin in the rack comes under the gathering palate *r*, and stops the motion of the whole machine, till the pin in the wheel 40 at the next hour takes the warning piece *i k*, and repeats the operation we have now described. As the gathering pallet turns once for each blow of the hammer, and its tooth gathers up one tooth of the rack at each turn, it is evident the number of teeth the rack is allowed to fall back limits the number of strokes the hammer will make. This is done by the rack's tail *t* resting on the snail; each step of the snail answers to one tooth of the rack, and one stroke of the hammer.

Plate LII, exhibits the principal parts of the mechanism of a common pocket watch.

The moving power is a spiral steel spring fig 3, which is coiled up close by a tool for the purpose, and put into a brass box, fig. 2, called the barrel: the spring has a hook at its outer end, which is put through a hole in the side of the barrel and rivetted; the inner end has an oblong opening cut through it, to receive a hook upon the barrel arbour, fig. 6. This arbour goes

through the bottom of the barrel, and is square to hold a worm-wheel *d*, fig. 5, which is turned round by a worm *b*; the ends of the arbour project below this, and it is pivoted into the lower plate A, fig. 8, of the watch; the top of the barrel has a cover put over it, through which the pivot of the arbour projects, and works in a socket in the upper plate D.

The barrel thus mounted has a steel chain *a*, figs. 1 and 8, hooked to its upper end, and coiled round it; the other end of this chain is hooked to the lower part of the fusee, figs. 1 and 8. It is evident, that when the fusee is turned by the watch key, it will wind the chain off the barrel on itself; and as one end of the spring is fastened to the barrel, and the other is hooked to the arbour (which is prevented from turning by the worm-wheel beneath,) the spring will be coiled up into a smaller compass than it was before; and by its re-action will, when the watch-key is taken off, turn the fusee, and keep the watch going. The fusee has a spiral groove cut round it, as shewn in fig. 4, in which the chain lies: this groove is cut by an engine, so that the chain shall pull from the smallest part of the fusee, when the spring is wound up, and act with its greatest force; and gradually increases in size as the spring unwinds, and acts with less power; so that the effect upon the great wheel *c*, figs. 1, 8, and 7, may be always the same, and cause the watch to go with regularity; and this effect can be at any time increased or diminished by turning the worm *b*, fig. 5, which coils the spring up closer, and causes it to act with greater force, or vice versa.

The fusee, fig. 4, has a ratchet wheel, at its lower end, which takes into a click fixed in a hollow cut in the great wheel, fig. 7, in order that when the watch is winding up, the fusee may slip round without the great wheel; and that when the spring draws it round in the other direction, it may move the great wheel with it, and the other wheels of the watch.

The great wheel *c* has 48 teeth, on its circumference, which take into and turn a pinion of 12 teeth, fixed on the same arbour with the centre wheel *b*, and fig. 9, which has 54 teeth to turn a pinion of six leaves on the arbour of the third wheel *h*, and fig. 10; the third wheel has 48 teeth, and turns a pinion of six on the arbor of the contrate wheel *i*, and fig. 11, which has 48 teeth cut parallel to its axis, by which it turns a pinion of six leaves, fixed to the balance-wheel *k*, figs. 8, 12, and 14. The pivots of the arbour of this wheel turn, one into a frame F, fig. 14, called the pottance, fixed to the upper plate; and the other in a small piece fixed to the upper part, called the counter pottance, so that when the two plates are put together, the balance-wheel pinion may work in the teeth of the contrate wheel. The balance wheel has 15 teeth, by which it impels the balance *l*, figs. 8, 13, and 15; the arbor of the balance, which is called the verge, has two pallets projecting from it nearly at right angles to each other; these are acted upon by the balance wheel, as shewn in fig. 14, where the lower pallet is supposed to be in contact with one of the teeth of the balance wheel, which, as it turns round, pushes the pallet round and the balance with it, till the balance has made about a quarter of a turn; the tooth of the balance wheel then slips off, and escapes. In this position the watch would run down, if it were not for the upper pallet at that instant taking another tooth on the opposite side of the balance wheel, which, as it moves in a contrary direction, pushes the balance back again till the tooth escapes the pallet; the lower pallet then engages the wheel as before. But for the better regulation of the time, the balance has a very fine spring *m*, fig. 15, called the pendulum spring, with the inner end fixed to the verge just beneath the balance, and the outer end pinned to a stud fixed to the top of the upper plate of the watch, so that the balance will rest only in one position, and if it is moved either way by the balance wheel, the spring will have a tendency to bring it to the same position again. When the lower pallet, for instance, has just liberated a tooth of the balance wheel, the pendulum spring is strained, and returns the balance to its point of rest instantaneously, the balance wheel following the upper pallet by the action of the main spring; and when the balance wheel comes to push the balance beyond its point of rest the other way, it moves slowly, because it has the elasticity of the pendulum spring to overcome.

It is evident, that by strengthening or weakening the spring, the velocity of the balance can be regulated, which is done by a contrivance shewn in fig. 15, and the under side of it in fig. 16. It is a plate of brass screwed to the top of the upper plate, close under the balance; and at one place it is hollowed out to receive a wheel *n*, which turns a segment of a wheel *p*, called the curb, which moves round in a circular groove: it has a projecting leaf *q*, with a notch in it to receive the pendulum spring; so that by turning the wheel with a key put on a square part of its arbor, the spring is lengthened or shortened, so as to give it a different power, and make the balance vibrate quicker, or slower; the arbour of the wheel *n*, has a dial *r*, fig. 15, upon it, with divisions to set it by. The upper pivot of the verge runs in a cock screwed to the upper plate, as shewn in fig. 8, which covers the balance, and protects it from violence; and the lower pivot works in the bottom of the pottance; the socket for the pivot of the balance wheel is made in a small piece of brass, which slides in a groove made in the pottance, as shewn in fig. 14; so that by drawing the slide in or out, the teeth of the balance wheel shall just clear one pallet before it takes the other.

The watch is so adjusted by the pendulum spring, that the balance shall vibrate so as to turn the centre wheel round once in an hour: the spindle of this projects through the lower plate, fig. 8, and has a tube fitted on it, which is square at the top, and carries the minute hand; the other end of this tube has a pinion of 12 teeth on it, which turns the minute wheel *s*, figs. 8 and 17, of 48, and its pinion of 16, which moves the hour wheel *t*, of 48 teeth: the spindle of this is a tube, which is put over the tube of the minute hand, and has the hour hand fixed on it to indicate the time upon the dial-plate.

WATER. It is scarcely necessary to give any definition or description of this universally known fluid. It is a very transparent fluid, possessing a moderate degree of activity with regard to organized substances, which renders

it friendly to animal and vegetable life, for both which it is indeed indispensably necessary. Hence it acts but slightly on the organs of sense, and is therefore said to have neither taste nor smell. It appears to possess considerable elasticity, and yields in a perceptible degree to the pressure of air in the condensing machine, as Canton proved, by including it in an open glass vessel with a narrow neck.

The solubility or insolubility of bodies in this fluid composes a large part of the science of chemistry.

Native water is seldom, if ever, found perfectly pure. The waters that flow within or upon the surface of the earth, contain various earthy, saline, metallic, vegetable, or animal particles, according to the substances over or through which they pass. Rain and snow waters are much purer than these, although they also contain whatever floats in the air, or has been exhaled along with the watery vapours.

WATER-BAILIFF, is an officer in seaport towns, appointed for the searching of ships; and in London, the water-bailiff hath the supervising and search of fish, brought thither, and the gathering of the toll arising from the Thames; his office is likewise to arrest men for debt, &c. or other personal or criminal matters upon the river Thames.

WATER-COLOURS. The general or simple colours, and the various species of each, fit for painting in water-colours, are as follow:

Whites.

Ceruse
Constant white
White lead
Spanish white
Flake white
Spodium.

Blacks.

Burnt cherry stones
Ivory black
Keating's black
Lamp black.

Greens.

Green bice
Green verditer
Grass green
Sap green
Verdigrise distilled.

Blues.

Sanders blue
Terre blue
Blue verditer
Indigo
Litmus
Smalt
Prussian blue
Light ditto
Ultramarine
Ultramarine ashes
Blue bice.

Browns.

Spanish brown
Spanish liquorice
Umber
Bistre
Burnt Terra de Sienna
Unburnt ditto.

Reds.

Native cinnabar
Burnt ochre
Indian red
Red lead
Minium
Lake
Vermilion
Carmine
Red ink
Indian lake.

Yellows.

English ochre
Gall-stone
Gamboge
Masticot
Ochre de luce
Orpiment
Roman ochre
Dutch pink
Saffron water
King's yellow
Gold yellow
French berries.

See Painting.

WATER COURSE. A water course does not begin by prescription, nor assent, but begins ex jure naturæ, having this course naturally; and cannot be diverted.

WATER *of crystallization.* Many salts require a certain proportion of water to enable them to retain the crystalline form, and this is called their water of crystallization. Some retain this so feebly, that it flies off on exposure to the air, and they fall to powder. These are the efflorescent salts. Others have so great an affinity for water, that their crystals attract more from the air, in which they dissolve. These are the deliquescent.

WATERMEN. In London, the lord mayor and court of aldermen have much power in governing the company of watermen, and appointing the fares for plying on the river Thames; and justices for Middlesex, and other adjoining counties, have also power to hear and determine offences, &c.

WATER-SPOUT, an extraordinary aqueous meteor, most frequently observed at sea. It is a truly formidable phenomenon; and is indeed capable of causing great ravages. It commonly begins by a cloud, which appears very small, and which mariners call the squall; which augments in a little time into an enormous cloud of a cylindrical form, or that of a reversed cone, and produces a noise like an agitated sea, sometimes emitting thunder and lightning, and also large quantities of rain or hail, sufficient to inundate large vessels, overset trees and houses, and every thing which opposes its violent impetuosity.

WATER-WORKS, in general, denote all manner of machines moved by, or employed in raising or sustaining water; in which sense water-mills of all kinds, sluices, aqueducts, &c. may be called water-works.

WAX. The upper surface of the leaves of many trees is covered with a varnish, which may be separated and obtained in a state of purity, and is found to possess all the properties of bees' wax: hence it is justly inferred that wax is a vegetable product, and that the bees extract it unaltered from the leaves of trees, and other vegetable substances that contain it. Several plants contain wax in such abundance as to make it worth while to extract it from them.

WAY, a road, or passage. A way may be by prescription, as if the owners and occupiers of such a farm have immemorially used to cross another's ground; for this immemorial usage supplies an original grant. A right of way may also arise by act and operation of law; for if a man grants to another a piece of ground in the middle of his field, he at the same time tacitly gives him a way to come at it, for where the law gives any thing to any person, it gives implied by whatever is necessary for enjoying the same.

Way *of a ship*, is sometimes used for her wake or track. But more commonly the term is understood of the course or progress which she makes on the water under sail: thus when she begins her motion, she is said to be under way.

WEASEL. See Viverra.

WEATHER. See Meteorology.

Weather-glasses, are instruments contrived to indicate the state or disposition of the atmosphere, and the various alterations in the weather: such are barometers, thermometers, hygrometers, &c.

WEAVING, is that art by means of which single threads, whether of cotton, silk, wool, or flax, are formed into a close fabric called cloth. To enter into the complicated mazes of this useful art, would require a volume of no ordinary size. It has somehow happened

that, till very lately, this art has been considered unworthy the notice of any writer who could do it justice; but this defect is amply supplied by the appearance of Mr. Murphy's volume on weaving, to which the reader is referred for all the information respecting the process which he may be in pursuit of. See also Duncan's Essays on the Art of Weaving.

WEDGE, one of the mechanical powers, as they are called. The wedge is a triangular prism, whose bases are equilateral acute-angled triangles. See MECHANICS.

WEEK, in chronology, a division of time comprising seven days. See CHRONOLOGY.

WEIGHT, in physics, is a quality in natural bodies, by which they tend towards the centre of the earth. See GRAVITATION. Weight may be distinguished into absolute, specific, and relative.

WEIGHT, in commerce, denotes a body of a known weight, appointed to be put in the balance against other bodies, whose weight is required.

WEIGHTS, *Modern English*. By the 27th chapter of Magna Charta, the weights all over England are to be the same; but for different commodities, there are two different sorts, viz. troy weight, and avoirdupois weight. The origin from which they are both raised, is a grain of wheat gathered in the middle of the ear.

In troy weight, twenty four of these grains make a pennyweight sterling, twenty pennyweights make one ounce, and twelve ounces one pound.

By this weight we weigh gold, silver, jewels, and liquors. The apothecaries also use the troy pound, ounce, and grain; but they differ from the rest in the intermediate divisions. They divide the ounce into eight drachms, the drachm into three scruples, and the scruple into twenty grains.

In avoirdupois weight, the pound contains sixteen ounces, but the ounce is less by near one-twelfth than the troy ounce, this latter contains 480 grains, and the former only 448. The ounce contains 16 drachms: 80 ounces avoirdupois are only equal to 73 ounces troy, and 17 pounds troy equal to 14 pounds avoirdupois.

By avoirdupois weight are weighed mercury, grocery, wares, base metals, wool, tallow, hemp, drugs, bread, &c.

Table of Troy Weight, as used by the Goldsmiths.

Grains.			
24	Pennyweights.		
480	20	Ounce.	
5760	340	12	Pound.

Apothecaries.

Grains.				
20	Scruple.			
60	3	Drachm.		
480	24	8	Ounce.	
5760	218	96	12	Pound.

Table of Avoirdupois Weight.

Scruples.					
3	Dram.				
24	8	Ounces.			
384	128	16	Pound.		
43008	14336	1792	112	Quintal, or hundred.	
860160	286720	35840	2240	20	Ton.

Mr. Ferguson gives the following comparison between troy and avoirdupois weight:

175 troy pounds are equal to 144 avoirdupois pounds.

175 troy ounces are equal to 192 avoirdupois ounces.

1 troy pound contains 5760 grains.

1 avoirdupois pound contains 7000 grains.

1 avoirdupois ounce contains 437½ grains.

1 avoirdupois dram contains 27.34375 grains.

1 troy pound contains 13 oz. 2.651428576 drams avoirdupois.

1 avoirdupois lb. contains 1 lb. 2 oz. 11 dwts. 16 gr. troy.

Therefore the avoirdupois lb. is to the lb. troy as 175 to 144, and the avoirdupois oz. is to the oz. troy, as 437½ is to 480.

The moneyers, jewellers, &c. have a particular class of weights for gold and precious stones, viz. carat and grain: and for silver, the pennyweight and grain. The moneyers have also a peculiar subdivision of the troy grain: thus, dividing

the grain into 20 mites,
the mite into 24 droits,
the droit into 24 periots,
the periot into 24 blanks.

The dealers in wool have likewise a particular set of weights, viz. the sack, weigh, tod, stone, and clove; the proportions of which are as below, viz.

the sack containing 2 weighs,
the weigh - - - 6½ tods,
the tod - - - - 2 stones,
the stone - - - 2 cloves,
the clove - - - 7 pounds,

Also 12 sacks make a last, or 4363 pounds.

Farther,

56 lb. of old hay, or 60 lb. new hay, make a truss.
40 lb. of straw make a truss.
36 trusses make a load of hay or straw.
14 lb. make a stone.
5 lb. of glass a stone.

WEIGHTS and MEASURES. The standard of measures was originally kept at Winchester, which measure was by the law of king Edgar, ordained to be observed throughout the kingdom. By stat. 35 G. III. c. 102, the justices in quarter-sessions in every county, are required to appoint persons to examine the weights and balances within their respective jurisdictions. These inspectors may seize and examine weights in shops, &c. and seize false weights and balances; and the offender being convicted before one justice, shall be fined

from 5s. to 20s. Persons obstructing the inspectors to forfeit from 5s. to 40s. Inspectors to be recompensed out of the county-rate. Standard weights to be purchased by the sessions out of the county-rate, and produced to all persons paying for the production thereof. Informations to be within one month.

WELD, or **Woald** (reseda luteola, Linn.), is a plant cultivated in Kent, Herefordshire, and many other parts of this kingdom. The whole of the plant is used for dyeing yellow; though some assert, that the seeds only afford the colouring matter.

Two sorts of weld are distinguished: the bastard or wild, which grows naturally in the fields; and the cultivated, the stalks of which are smaller and not so high. For dyeing, the latter is preferred, it abounding more in colouring matter. The more slender the stalk, the more it is valued.

WELDING. Welding is that intimate union produced between the surfaces of two pieces of malleable metal, when heated almost to fusion, and hammered.

WHALE. See Balæna.

Whale fishery. See Fishery.

WHARF, a space on the banks of a haven, creek, or hithe, provided for the convenient loading and unloading of vessels upon.

WHEAT. See Triticum, and Husbandry.

WHEAT-EAR. See Motacilla.

WHEEL, in mechanics, a simple machine, consisting of a round piece of wood, metal, or other matter, which revolves on an axis. The wheel is one of the principal mechanic powers; it has place in most engines; in effect, it is of an assemblage of wheels that most of our engines are composed.

WHEEL-ANIMALS, *brachionus*, a genus of animalcules which have an apparatus of arms for taking their prey.

WHIRLPOOL, an eddy, vortex, or gulph, where the water is continually turning round. These in rivers are very common, from various accidents, and are usually very trivial, and of little consequence. In the sea they are more rare but more dangerous.

WHIRLWIND, a wind that rises suddenly, is exceedingly rapid and impetuous, in a whirling direction, and often progressively also; but it is commonly soon spent. Dr. Franklin, in his Physical and Meteorological Observations, read to the Royal Society in 1756, supposes a whirlwind and a waterspout to proceed from the same cause: their only difference being, that the latter passes over the water, and the former over the land. This opinion is corroborated by the observations of many others, who have remarked the appearances and effects of both to be the same. They have both a progressive as well as a circular motion; they usually rise after calms and great heats, and mostly happen in the warmer latitudes: the wind blows every way from a large surrounding space, both to the water-spout and whirlwind; and a water-spout has, by its progressive motion, passed from the sea to the land, and produced all the phenomena and effects of a whirlwind; so that there is no reason to doubt that they are meteors arising from the same general cause, and explicable upon the same principles, furnished by electrical experiments and discoveries.

WHISPERING-PLACES depend upon this principle: if the vibrations of the tremulous body are propagated through a long tube, they will be continually reverberated from the sides of the tube into its axis, and by that means prevented from spreading, till they get out of it: whereby they will be exceedingly increased, and the sound rendered much louder than it would otherwise be.

WHIST, a well-known game at cards, which requires great attention and silence; hence the name.

WICKLIFFISTS, or *Wicklifites*, a religious sect which sprang up in England in the reign of Edward III. and took its name from John Wickliff, doctor and professor of divinity in the university of Oxford, who maintained that the substance of the sacramental bread and wine remained unaltered after consecration; and opposed the doctrine of purgatory, indulgences, auricular confession, the invocation of saints, and the worship of images. He maintained that children may be saved without being baptised; that priests may administer confirmation; that there ought to be only two orders in the church, that of priests, and that of deacons. He made an English version of the Bible, and composed two volumes, called Alethia, that is, Truth, from which John Huss learned most of his doctrines.

WIDOW, a woman who has lost her husband by death. In London, and throughout the province of York, the widow of a freeman is by custom entitled to her apparel, and the furniture of the bed-chamber, called the widow's chamber.

WIFE. After marriage, all the will of the wife, in judgment of law, is subject to the will of the husband, and it is commonly said a feme coverte has no will.

WILDERNESS, in gardening, a kind of grove of large trees, in a spacious garden, in which the walks are commonly made either to intersect each other in angles, or have the appearance of meanders and labyrinths.

WILL. In the Hartleyan acceptation of the term, the will is that state of mind which is immediately previous to, and causes, those express acts of memory, imagination, reasoning, or bodily motion, which we term voluntary; corresponding to the common acceptation of the term *volition*. In the more customary use of the term, it comprehends the whole class of feelings by which volition is produced.

WILL *and* **TESTAMENT**, in law. Every person capable of binding himself by contract, is capable of making a will. Also a male infant of the age of 14 years and upwards, and female of twelve years and upwards, are capable of making a will respecting personal estates only. But a married woman cannot make a will unless a power is reserved in a marriage settlement; but wherever personal property, however, is given to a married woman for her sole and separate use, she may dispose of it by will. If a feme sole makes her will, and afterwards marries, such marriage is a legal revocation of the will. Wills are of two kinds, written and verbal; the former are most usual and secure. It is not absolutely necessary that a will should be witnessed; and a testament of chattels, written in the testator's own hand, though it should have neither the testator's name

nor seal to it, nor witnesses present at his publication, will be good, provided sufficient proof can be had that it is his hand-writing.

A codicil is a supplement to a will, or an addition made by the person making the same, annexed to, and to be taken as part of, the will itself, being for its explanation or alteration, to add something to, or take something from, the former disposition, and which may also be either written or verbal under the same restrictions as regard wills.

WIND. See METEOROLOGY.

WINDS, *trade*. See METEOROLOGY.

WINDMILL, a kind of mill, the internal parts of which are much the same with those of a water mill; from which, however, it differs in being moved by the impulse of the wind upon its vanes, or sails, which are to be considered as a wheel on the axle.

WINDLASS, or **WINDLACE**, a machine used to raise large weights, as guns, stones, anchors, &c. See MECHANICS.

WIND-SAILS, in a ship, are made of the common sail-cloth, and are usually betwen 25 and 30 feet long, according to the size of the ship, and are of the form of a cone ending obtusely.

WINDWARD, in the sea langrage, denotes any thing towards that point from which the wind blows in respect of a ship: thus, windward tide is the tide which runs against the wind.

WINDAGE *of a gun, mortar, or howitzer.* The difference between the diameter of the bore, and the diameter of the shot or shell.

WINE. All wines contain an acid, alcohol, tartar, extract, aroma, and colouring matter. The presence and nature of each of these principles may be ascertained in the following way:—

1. Acid. All wines, even the softest and mildest, redden litmus, and therefore contain an acid. This abounds, however, chiefly in the thin wines of wet and cold climates, where the grape juice or must contains but a small portion of sugar. When wine has been boiled to extract the brandy, the liquor that remains in the still, and is thrown away as useless, is a sour nauseous fluid with an acrid and burnt flavour. When filtered and allowed to remain at rest for a time, it deposits a good deal of extractive matter, becomes covered with mould, and then contains a notable quantity of acetous acid, which may be separated by distillation. The wines that contain the greatest quantity of these acids yield the worst brandy, nor is there any method yet known of separating or neutralizing the acid without materially injuring the quality, or lessening the quantity of the ardent spirit. 2. Alcohol. The existence of this principle and mode of extraction by distillation has been fully described under the article brandy. The quantity of alcohol varies prodigiously. The strong, rich, full-bodied wines of the warmer vine countries will yield as much as a third of ardent spirit; whilst the thin light wines will often give no more than about one-sixteenth of the same strength. 3. Tartar. This substance has also been fully described in its proper place. Tartar is not altogether a product of the fermentation of wine, since it is contained in must, though in small quantity. 4. Extract. Must contains an abundance of extractive matter, which materially assists the fermentation, and is afterwards found, in part at least, in the lees, but another portion may be obtained from the wine by evaporation. It is also extract that mixes with and colours the tartar. By age the quantity of extractive matter diminishes. 5. Aroma. All wines possess a peculiar and grateful smell, which would indicate a distinct aromatic principle, but it has never been exhibited in the form of essential oil, or condensed in any smaller quantity by distillation or any other mode. To give wine all its aroma it should be fermented very slowly. 6. Colouring matter. The husk of the red grape contains a good deal of colour, which is extracted when the entire fruit is pressed, and becomes dissolved in the wine when the fermentation is complete. Many substances will separate the colour. If lime-water is added to high-coloured wine, a precipitate is formed of malat of lime that carries down with it all the colouring matter, which cannot again be separated either by water or alcohol. But if wine alone is evaporated gently to dryness, and the residue treated with alcohol, the colouring matter dissolves therein. We may add, too, that the natural colour of wine is entirely and speedily destroyed by the addition of hot well-burnt charcoal in pretty fine powder. The colour of red wine in the state in which we receive it is not entirely that of the grape, but is given by other colouring substances, which, however, are quite innoxious.

WINGED, in botany, a term applied to such stems of plants as are furnished all their length with a sort of membranaceous leaves, as the thistle, &c.

WINNOWING MACHINES. Machines of this sort are in pretty general use where thrashing-mills, to which they may be attached, are not erected; they are made on different principles, according to particular circumstances.

WIRE, a piece of metal drawn through the hole of an iron into a thread of a fineness answerable to the hole it passed through.

Wires are frequently drawn so fine as to be wrought along with other threads of silk, wool, flax, &c.

The metals most commonly drawn into wire are gold, silver, copper, and iron.

Gold wire is made of cylindrical ingots of silver, covered over with a skin of gold, and thus drawn successively through a vast number of holes, each smaller and smaller; till at last it is brought to a fineness exceeding that of a hair. That admirable ductility which makes one of the distinguishing characters of gold, is no where more conspicuous than in this gilt wire. A cylinder of 48 ounces of silver, covered with a coat of gold, only weighing one ounce, as Dr. Halley informs us, is usually drawn into a wire, two yards of which weigh no more than one grain: whence 98 yards of the wire weigh no more than 49 grains, and one single grain of gold covers the 98 yards, so that the ten-thousandth part of a grain is above one-eighth of an inch long.

Wires are drawn square, and of other figures in their sector. In particular they are drawn grooved, so that any small part will form the pinion of a clock or watch work.

As the violent action of the drawing plate renders the wire hard and brittle, it is necessary to anneal it several times during the course of drawing. Very small holes are made by

hammering up the larger, and the point, in very thin wire, is made by rolling or crushing the end by a smooth burnishing tool upon a polished plate.

WIT, a faculty of the mind, consisting, according to Mr. Locke, in the assembling and putting together of those ideas, with quickness and variety, in which any resemblance or congruity can be found, in order to form pleasant pictures and agreeable visions to the fancy. This faculty, the same author observes, is just the contrary of judgment, which consists in the separating carefully from one another, such ideas wherein can be found the least difference, thereby to avoid being misled by similitude and affinity, to take one thing for another. It is the metaphor and allusion, wherein, for the most part, lies the entertainment and pleasantry of wit, which strikes so lively on the fancy, and is therefore so acceptable to all people, because its beauty appears at first sight, and there is required no labour of thought to examine what truth or reason there is in it. The mind, without looking any further, rests satisfied with the agreeableness of the picture, and the gaiety of the imagination; and it is a kind of affront to go about to examine it by the severe rules of truth or reason. Wit is also an appellation given to the person possessed of this faculty.

WITENA-MOT, or WITENA-GEMOT, among our Saxon ancestors, was a term which literally signified the assembly of the wise men, and was applied to the great council of the nation, of latter days called the parliament.

WITHERNAM, in law, a writ that lies where a distress is driven out of the county, and the sheriff cannot make deliverance to the party distrained; in that case, this writ is directed to the sheriff, commanding him to take as many of the beasts, or goods, of the party into his keeping till he make deliverance of the first distress.

WITNESS, one who is sworn to give evidence in a cause. If a man is subpœnaed as a witness upon a trial, he must appear in court on pain of £100 to be forfeited to the king, and £10 together with damages equivalent to the loss sustained by the want of his evidence to the party aggrieved.

Where a witness cannot be present at a trial, he may, by consent of the plaintiff and defendant, or by rule of court, be examined upon interrogatories at the judges' chambers. No witness is bound to appear to give evidence in a cause unless his reasonable expence is tendered him, nor need he appear till such charge is actually paid him, except he both resides and is summoned to give evidence within the bills of mortality.

WOAD, isatis, glastum, is a plant which grows wild in some parts of France, and on the coast of the Baltic Sea; the wild woad, and that which is cultivated for the use of the dyers, appear to be the same species of plant. See DYEING.

WOLFRAM. See MINERALOGY.

WOOD, *cutting in*, is used for various purposes; as for initial and figured letters, head and tail-pieces of books; and even for schemes, mathematical and other figures, to save the expense of engraving on copper: and for prints, and stamps for papers, calicoes, linens, &c. The invention of cutting in wood, as well as that in copper, is ascribed to a goldsmith of Florence but Albert Durer and Lucas brought both these arts to perfection. About two hundred years ago, the art of cutting in wood was carried to a very great pitch, and might even vie, for beauty and neatness, with that of engraving on copper. See ENGRAVING.

WOODY-FIBRE, or LIGNIN. If a piece of wood be boiled in a great quantity of water, till it no longer gives out taste or smell, and if it be afterwards digested in alcohol, the substance which remains is the woody fibre. It is either in a fibrous, lamellated, or pulverulent form. This substance, which is more or less coloured, has neither taste nor smell; is not altered by exposure to the air; and is insoluble in water and alcohol. When it is heated in contact with air, it blackens, exhales dense, acrid, pungent fumes, and leaves behind a coaly matter, which does not change its form. By reducing it to ashes, it is found to contain a little potash, sulphate of potash and lime, and phosphate of lime. When it is distilled in a retort it yields water, acetic acid contaminated with oil, a thick oily matter, carbonated hydrogen, and carbonic acid gases, and a portion of ammonia, combined with acetic acid. The pure ligneous fibre is decomposed by being heated with strong nitric acid, and yields a very considerable quantity of oxalic and malic acid.

WOOL, the covering of sheep. Each fleece consists of wool of several qualities and degrees of fineness, which the dealers therein take care to separate by a process called wool-sorting.

The fineness and plenty of our wool is owing in a great measure, to the short sweet grass in many of our pastures and downs; though the advantage of our sheep feeding on this grass all the year, without being obliged to be shut up under cover during the winter, or to secure them from wolves at other times, contributes not a little to it.

WOOL-COMBERS. By 35 G. III., c. 124, all those who have served an apprenticeship to the trade of a wool-comber, or who are by law entitled to exercise the same, and also their wives and children, may set up and exercise such trade, or any other trade or business they are apt and able for, in any town or place within this kingdom, without any molestation; nor shall they be removeable from such place by the poor laws.

WORD, in a military sense, signifies signal, token, order, as watch-word.

The WORD, *Watch* WORD, is a peculiar word that serves for a token and mark of distinction, given out in the orders of the day in time of peace, but in war every evening in the field, by the general who commands, and in garrison by the governor, or other officer commanding in chief, to prevent surprise, and hinder an enemy, or any treacherous person, from passing backwards and forwards.

WORD, in language, an articulate sound, representing some idea or conception, of the mind. The copiousness of the English language is proved by the following enumeration of the words in Johnson's Dictionary;

Articles	3
Nouns substantive	20409
Adjectives	9053
Pronouns	41

Verbs	active	5445	7880
	neuter	2425	
	passive	1	
	defective (or imperfect)	5	
	auxiliary	1	
	impersonal	3	
Verbal noun			1
Participles			38
Participial	adjectives		125
	nouns		3
Adverbs		496	2592
——— in *ly*		2096	
Prepositions			69
Conjunctions			19
Interjections			63
Total			40301

It must be remarked, however, that in this list many of the compound words are not reckoned; that the participles are those only having no verbs to which they may be referred, as *beloved*; that though so few verbal and participial nouns are stated by Johnson, yet every active verb may supply one of the former description, and every verb one of the latter; and that both these (verbal and participial nouns) seem to be merely different applications of a true gerund.

WORKING *in harvest.* A person may go abroad to work in harvest, carrying with him a certificate from the minister, and one churchwarden or overseer, that he has a dwelling-house or place, in which he inhabits, and has left wife and children, or some of them, there (or elsewhere as his condition shall require,) and declaring him an inhabitant there. A person carrying such certificate with him shall not be apprehended under the stat. 17 G. II. c. 5, commonly called the vagrant act.

WORMS. See VERMES, and MEDICINE.

WORMWOOD. See ARTEMISIA.

WORSTED, a kind of woollen thread, which, in the spinning, is twisted harder than ordinary. It is chiefly used either wove or knit into stockings, caps, gloves, or the like.

WREATH, in heraldry, a roll of fine linen or silk consisting of the colours borne in the escutcheon, placed in an achievement between the helmet and the crest, and immediately supporting the crest.

WRECK, such goods as, after a shipwreck, are cast upon the land by the sea, and left there within some county, for they are not wrecks so long as they remain at sea, being within the jurisdiction of the Admiralty.

WREN. See MOTACILLA.

WRIST. See ANATOMY.

WRIT, is the king's precept, by which any thing is commanded touching a suit or action; as the defendant or tenant to be summoned, a distress to be taken, a disseisin to be redressed, &c. And these writs are diversely divided; some in respect of their order, or manner of granting, are termed original, and some judicial.

WRIT *of inquiry of damages,* a judicial writ that issues out to the sheriff, upon a judgment by default, in action of the case, covenant, trespass, trover, &c. commanding him to summon a jury to enquire what damages the plaintiff has sustained occasione præmissiorum; and when this is returned with the inquisition, the rule for judgment is given upon it: and if nothing is said to the contrary, judgment is thereupon entered.

WRITERS *to the Signet,* a term used in Scotland to designate solicitors, who conduct causes before the courts of Edinburgh; they are so named from their having had the exclusive right of preparing papers which required the king's signet.

WRONG *stamp.* By 37 George III. c. 136, any instrument (except bills of exchange, promissory notes, or other notes, drafts, or orders) liable to stamp-duty, whereon shall be impressed any stamp of a different denomination, but of an equal or greater value than the stamp required, may be stamped with the proper stamp after the execution, on payment of duty and five pounds penalty, but without any allowance for the wrong stamp.

Likewise any such instrument (except as aforesaid) being engrossed without having been first stamped, or having a stamp thereon of less value than required, the same may be stamped after the execution, on payment of the duty and ten pounds penalty only, for each skin thereof: but in case it shall be satisfactorily proved to the commissioners of stamps, that the same hath been so engrossed either by accident or inadvertency, or from urgent necessity, or unavoidable circumstances, and without any intention of fraud, the Commissioners are authorized to stamp the same within sixty days after the execution, to remit the penalty in part, or in all, and to indemnify persons so engrossing the same.

WURMBEA, a genus of plants of the class and order hexandria trigynia. There are three species, herbs of the Cape.

X.

X, or x, the twenty-second letter of our alphabet. In numerals it expresses 10, whence in old Roman manuscripts it is used for denarius; and as such seems to be made of two V's placed one over the other. When a dash is added over it, thus $\bar{X}$, it signifies ten thousand.

XANTHE, a genus of plants of the class and order dioecia syngenesia. There are two species, shrubs of Guiana.

XANTHIUM, a genus of plants of the class monoecia, order pentandria, and arranged in the natural classification under the 49th order compositæ. There are five species, only one of which is a native of Britain, the strumarium or lesser burdock. Horses and goats eat it; cows, sheep, and swine, refuse it.

XANTHIORZA, a genus of plants of the class and order pentandria polygamia. There [illegible]ies, a shrub of North America.

XANTHOXYLUM, the tooth ache tree, a genus of plants of the class and order diœcia pentandria. There is one species, a tree of Jamaica.

XIMENIA, a genus of plants of the class and order pentandria monogynia. The calyx is a perianthium, composed of three small, cordated and deciduous leaves. There are three species, trees of the West Indies.

XIPHIAS, the *sword-fish*, in natural history, a genus of fishes of the order, apodes; generic character: head with the upper jaw ending in a sword shaped snout: mouth without teeth: gill-membrane eight-rayed; body roundish, without scales. There are three species; Xiphias, gladeus, or the common sword-fish, is of the length of twenty-feet, and is particularly distinguished by its upper jaw being stretched to a considerable distance beyond the lower, flat above and beneath, but edges at the sides, and of a bony substance, covered by a strong epidermis. It is a fish extremely rapacious, and finds in the above instrument a weapon of attack and destruction, able to procure it the most ample supplies. It first transfixes its prey with this snout, and then devours it. It is found in the Mediterranean, chiefly about Sicily, and is used as food by the Sicilians, who preserve it for a long time [illegible], salting it in small pieces.

Xiphias, *platypterus*, or the broad-finned sword-fish, is found in the Northern, Atlantic, and Indian Seas, and is considered as one of the most fatal enemies of the whale tribe. Its strength is so great that it is said to have pervaded with its snout, or sword, the plank of an East Indiaman; and a plank and snout in attestation of this circumstance, the latter closely driven [illegible] the former, are to be seen in the British Museum, having been communicated to Sir Joseph Banks by an East India Captain, of honour and veracity. When young this fish is used for food, but after it exceeds four or five feet in length.

XIPHIDIUM, a genus of plants of the class and order triandria monogynia. There is one species, a herb of the West Indies.

XYLO-ALOES, or ALOE-WOOD, in pharmacy. See EXCOECARIA.

XYLOCARPUS, a genus of plants of the class and order octandria monogynia. There is one species, a tree of the East Indies.

XYLOPHYLLA, a genus of plants of the class and order pentandria trigynia. There are seven species, shrubs of the West Indies.

XYLOPIA, a genus of plants of the class and order polyandria polygynia. There are three species, trees of the West Indies.

XYLOSMA, a genus of plants of the class and order dioecia polyandria. There are two species

XYRIS, a genus of the triandria monogynia class of plants, the flower of which consists of three plain, patent, large, crenated petals, with narrow ungues, of the length of the cup There are three species.

Y.

Y, the twenty-third letter of our alphabet. [illegible] is a numeral, signifying 150, or according to Baronius, 159; and with a dash at top, as $\overline{Y}$, it signifies 150,000.

YACHT. This word is taken from the Dutch. It is a small ship with one deck, carrying four, eight, or twelve guns, and thirty or forty men. Yachts, in general, are from thirty to 160 tons; contrived and adorned both withinside and without, for carrying state passengers. They answer the purposes of business as well as pleasure, being remarkably good sailers.

YANOLITE, AXINITE, or THUMERSONE, which see.

YARD. See MEASURE.

YARDS *of a ship*, are those long pieces of timber which are made a little tapering at each end, and are fitted each athwart its proper mast, with the sails made fast to them, so as to be hoisted up, or lowered down, as occasion serves. They have their names from the masts to which they belong.

Yards also denote places belonging to the navy, where the ships of war, &c. are laid up in harbour. There are, belonging to his Majesty's navy, six great yards, viz. Chatham, Deptford, Woolwich, Portsmouth, Sheerness, and Plymouth; these yards are fitted with several docks, wharfs, launches, and graving places, for the building, repairing, and cleaning of his majesty's ships; and therein are lodged great quantities of timber, masts, planks, anchors, and other materials: there are also convenient store-houses in each yard, in which are laid up vast quantities of cables, rigging, sails, blocks, and all other sorts of stores, needful for the royal navy.

YARD ARM is that half of the yard that is on either side of the mast, when it lies athwart the ship.

YEAR, the time that the sun takes to go through the twelve signs of the zodiac. See CHRONOLOGY.

Year, or *solar year*, properly, and by way of eminence so called, is the space of time in which the sun moves through the twelve signs of the ecliptic. This, by the observations of the best modern astronomers, contains 365 days, 5 hours, 48 minutes, 48 seconds; the quantity assumed by the authors of the Gregorian calendar is 365 days, 5 hours, 49 minutes. But in the civil or popular account, this year contains only 365 days, except every fourth year, which contains 366.

Common civil year, is that consisting of 365 days; having seven months of thirty-one days each, four of thirty days, and one of twenty-eight days; as indicated by the following well-known memorial lines:

> Thirty days have September,
> April, June, and November;
> February twenty-eight alone,
> And all the rest have thirty-one.

Bissextile or leap-year, consists of 366 days, having one day extraordinary, called the intercalary, or bissextile day, which takes place every fourth year.

YEAR *and* **DAY**, is a time that determines a right in many cases; and in some works an usurpation, and in others a prescription; as in case of an estray, if the owner

proclamation being made, challenges it not within the time, it is forfeited. So is the year and day given in case of appeal; in case of descent after entry or claim, if no claim [illegible] on a fine or writ of right at the common law; so of a villein remaining in ancient demesne; of a man sore bruised or wounded; of protections; essoins in respect of the king's service; of a wreck; and divers other cases.

YEAR DAY *and* **WASTE**, is a part of the king's prerogative, whereby he challenges the profits of their lands and tenements for a year and a day, that are attainted of petty treason or felony, whoever is lord of the manor where the lands or tenements belong; and not only so, but in the end may waste the tenements, destroy the houses, root up the woods, garden, and pasture, and plough up the meadows, except the lord of the fee agrees with him for redemption of such waste afterwards restoring it to the lord of the fee.

YEARS *estate for*. Tenant for term of years, is where a man lets land or tenements to another, for a certain term of years agreed upon between the lessor and lessee; and when the lessee enters by force of the lease, then he is tenant for term of years.

YEAST, or *barm*, is the head, or scum which rises upon beer or ale during the process of fermentation. It is used for a leaven or ferment in the baking of bread, as serving to swell or puff it up very considerably in a little time, and to make it much lighter, softer, and more delicate. When there is too much of it, it renders the bread bitter. The following beautiful description of this process is given by Dr. Ure, in his Dictionary.

It is to the gluten that wheat flour owes its property of making a fermentable dough with water. This flour paste may indeed be regarded as merely a viscid and elastic tissue of gluten, the interstices of which are filled with starch, albumen, and sugar. We know that it is from the gluten that the dough derives its property of rising on the admixture of leaven. The leaven acting on the sweet principle of the wheat, gives rise in succession to the vinous and acetous fermentations, and of consequence to alcohol, acetic and carbonic acids. The latter gas tends to fly off, but the gluten resists its disengagement, expands like a membrane, forms a multitude of little cavities, which give lightness and sponginess to the bread. For the want of gluten, the flour of all those grains and roots which consist chiefly of starch are not capable of making raised bread, even with the addition of leaven or yeast. There does not appear to be any peculiar fermentation to which the name *panary* should be given.

This invaluable article in domestic economy is, at certain seasons of the year, very scarce in this country, and at those times what is to be obtained is generally of an inferior quality. Various expedients have been tried to remedy this defect, but the best ever made known to the public is unquestionably that described by Mr. W. Cobbet, as practised by the people of Long Island, America, which is as follows:

Rub between the hands three ounces of hops, so as to separate them, and then put them into a gallon of boiling water, where they are to boil for half an hour. Now strain the liquor through a fine sieve into an earthen vessel, and while it is hot, put in three pounds and a half of rye flour; stirring the liquor well, and quickly as the flour is put in. When it has become as cool as wort for brewing, add half a pint of good yeast. On the following day, whilst the mixture is fermenting or working, stir well into it seven pounds of Indian-corn meal; this will render the whole mass stiff like dough; this dough is to be well kneaded and rolled out into cakes about a third of an inch in thickness. These cakes are to be cut out into large disks, or lozenges, or any other shape, by an inverted tumbler or other instrument; and being placed on a sheet of tinned iron, or on a piece of board, are to be dried by the heat of the sun. If care be taken that they are frequently turned, and that they receive no wet or moisture, they will become as hard as ship-biscuit, and may be kept in a bag or box, which is to be hung up, or kept in an airy and perfectly dry situation. When bread is to be made, two cakes of the above mentioned thickness, and about three inches in diameter, are to be broken and put into hot water, where they are to remain all night; the vessel standing near the fire. In the morning they will be entirely dissolved, and then, the mixture is to be employed in setting the sponge in the same way that beer yeast is used.

YELLOW *earth*, named by Werner, gelberde, is of a yellow ochre colour of various degrees of intensity. It is massive, soft and friable: it adheres strongly to the tongue and feels greasy. It occurs in beds with iron-stone in Upper Saxony, and is employed as a yellow pigment.

YELLOW, *Naples*, a fine pigment so called from the city in which it was long prepared. It has the appearance of an earth, is very friable, heavy, porous, and not altered by exposure to the air.

YEOMAN, is defined to be one that hath fee land of 40*s*. a year; who was thereby, heretofore, qualified to serve on juries, and can yet vote for knights of the shire, and do any other act where the law requires one that is *probus et legalis homo*.

YEOMAN *of the guard*, one belonging to a sort of foot guards, who attend at the palace. The yeomen were uniformly required to be six feet high. They are in number 100 on constant duty, and 70 off duty. The one half carry arquebuses, and the other pertuisans. Their attendance is confined to the sovereign's person, both at home and abroad. They are clad after the manner of king Henry VIII.

YEW. See TAXUS.

YOKE, in agriculture, a frame of wood, fitted over the necks of oxen, whereby they are coupled together, and harnessed to the plough.

YOLK, a word used to designate the yellow part of an egg, from which the chick is produced. In the yolk of eggs there is a considerable quantity of oily matter, which may be obtained by pressure after boiling. This oil is yellow and tasteless.

The term yolk is also used for an animal soap which is found in wool, and which seems designed by nature as a preservative of that article.

YTTRIA. This is a new earth discovered in 1794 by Prof. Gadolin, in a stone from Ytterby in Sweden. See GADOLINITE.

It may be obtained most readily by fusing

the gadolinite with two parts of caustic potash, washing the mass with boiling water, and filtering the liquor, which is of a fine green.

Yttria is perfectly white, when not contaminated with oxide of manganese, from which it is not easily freed. Its specific gravity is 4.842. It has neither taste nor smell. It is infusible alone; but with borax melts into a transparent glass, or opaque white if the borax were in excess. It is insoluble in water, and in caustic fixed alkalis; but it dissolves in carbonate of ammonia, though it requires five or six times as much as glucine. It is soluble in most of the acids.

When yttria is treated with potassium in the same manner as the other earths, similar results are obtained; the potassium becomes potash, and the earth gains appearances of metallization; so that it is scarcely to be doubted, says Sir H. Davy, that yttria consists of inflammable matter, metallic in its nature, combined with oxygen.

YUCCA, *Adam's needle*, a genus of plants of the class *hexandria*, and order *monogynia*. There are four species, but none of them natives of Britain.

YUNX, in zoology, a genus of birds of the order picæ. The bill is short, roundish, and pointed; the nostrils concave and naked; the tongue very long and cylindric; there are two fore and two hind claws. There is only one species, the torquilla, wry-neck, which is a native of Europe, Asia, and Africa, and is often seen in Britain.

Z

Z, the twenty-fourth and last letter of our alphabet.

In abbreviations this letter formerly stood as a mark for several sorts of weights; sometimes it signified an ounce and a half, and very frequently it stood for half an ounce; sometimes for the eighth part of an ounce, or a dram troy weight; and it has in earlier times been used to express the third part of an ounce, or eight scruples.

Z Z were used by the ancient physicians to express myrrh, and they are sometimes used at present to signify zinziber, or ginger.

ZAFFRE, is the oxide of cobalt, employed for painting pottery-ware and cobalt of a blue colour. See COBALT.

ZAMIA, a genus of the natural order of palmæ. The ament is shobile-shaped, scales with pollen underneath; fem. ament. shobile-shaped with scales at each margin; berry solitary. There are five species.

ZANNICHELLIA, horned pond-weed, a genus of the monœcia monandria class of plants, the male flower of which consists only of a single stamen; it has neither calyx nor corolla. In the female flower the calyx is composed of a single leaf; there is no corolla. There is one species.

ZEA, *Indian corn*, a genus of plants of the class monœcia, order triandria. There is only one species, the mays, or maize. The Indians in New England, and many other parts of America, have no other vegetable but maize or Indian corn for making their bread. They call it weachin, and in the United States of America there is much of the bread of the country made of this grain, not of the European corn. In Italy, Germany, Spain, and Portugal, maize constitutes a great part of the food of the poor inhabitants.

ZEBRA. See EQUUS.

ZENITH, in astronomy, the vertical point; or a point in the heavens directly over our heads.

ZEOLITE. See MINERALOGY.

ZERO, signifies the commencement of the graduation of the scale of the thermometer, and is marked 0. In Farenheit's thermometer this is 32° below the freezing point; and in Reamur it coincides with the freezing point, as it does also in the centigrade thermometer

ZEUS, in ichthyology, a genus of fishes of the order of thoracici. The head is compressed and declines, the upper lip being vaulted over by a transverse membrane; the tongue is subulated; there are seven rays in the gill-membrane; and the body is compressed. The species are eight; of which the most remarkable is the faber or doree.

ZIMOME. The gluten of wheat, treated by alcohol, is reduced to the third part of its bulk. This diminution is owing, not merely to the loss of gliadine, but likewise to that of water The residue is zimome, which may be obtained pure by boiling it repeatedly in alcohol, or by digesting it in repeated portions of that liquid cold, till it no longer gives out any gliadine.

ZINC is a metal of a bluish-white colour, somewhat brighter than lead; of considerable hardness, and so malleable as not to be broken with the hammer, though it cannot be much extended in this way. It is very easily extended by the rollers of the flatting mill. Its specific gravity is from 6.9 to 7.2. See CHEMISTRY.

ZIRCON. See MINERALOGY.

ZIZANIA, a genus of plants of the class monœcia, order hexandria; and in the natural system arranged under the 4th order, gramina. There are two species; the aquatica and terrestris, none of which are natives of Britain.

ZODIAC. See ASTRONOMY.

ZODIACAL *light*, a brightness sometimes observed in the zodiac, resembling that of the galaxy, or milky way. It appears at certain seasons, viz. towards the end of winter, and in spring after sun-set, or before his rising in autumn and beginning of winter, resembling the form of a pyramid, lying lengthways with its axis along the zodiac, its base being placed obliquely with respect to the horizon.

ZONE, in geography and astronomy, a division of the terraqueous globe, with respect to the different degree of heat found in [illegible] parts. A zone is the fifth part of the surface of the earth, contained between two parallels. The zones are denominated torrid, frigid, and temperate. The torrid zone is a band surrounding the terraqueous globe, and terminate

by the two tropics Its breadth is 46 deg 58 min The equator, running through the middle of it, divides it into two equal parts, each containing 23 deg 29 min. The ancients imagined the torrid zone uninhabitable The temperate zones are two bands, environing the globe, and contained between the tropics and the polar circles, the breadth of each is 43 deg 2 min. The frigid zones are segments of the surface of the earth, terminated, one by the antarctic, and the other by the artic circle The breadth of each is 46 deg 38 min

ZOOLOGY, is that part of natural history which relates to animals

In order to abridge the study of zoology, many methods of reducing animals to classes, genera, and species, have been invented but as that of Linnæus is undoubtedly the best, the most extensive, and the most generally adopted, we shall give a brief account of it

Linnæus divides the whole animal kingdom into six classes The characters of these six classes are taken from the internal structure of animals, in the following manner —

Class I *Mammalia* includes all animals that suckle their young The characters of this class are these The heart has two ventricles and two auricles, the blood is red and warm, and the animals belonging to it are viviparous.

Class II *Aves*, or birds The characters are the same with those of Class I excepting that the animals belonging to it are oviparous

Class III *Amphibia*, or amphibious animals The heart has but one ventricle and one auricle, the blood is red and cold, and the animals belonging to this class have the command of their lungs, so that the intervals between inspiration and expiration are in some measure voluntary

Class IV *Pisces*, or fishes The heart has the same structure, and the blood the same qualities with those of the amphibia but the animals belonging to this class are easily distinguished from the amphibia by having no such voluntary command of their lungs, and by having external branchiæ or gills

Class V *Insecta* or insects The heart has one ventricle, but no auricle the blood is cold and white, and the animals are furnished with antennæ or feelers See Insect

Class VI *Vermes* or worms The characters are the same with those of Class V only the animals have no antennæ, and are furnished with tentacula

For subdivision of these classes into orders see under the various articles, *Mammalia*, *Aves*, *Amphibia*, *Pisces*, *Insecta*, and *Vermes*

ZOOPHYTA, in natural history, an order of the class vermes Zoophyta are composite animals, holding a medium between animals and vegetables Most of them take root and grow up into stems, multiplying life in their branches and deciduous buds and in the transformation of their animated blossoms or polypes, which are endowed with spontaneous motion. Plants, therefore, resemble zoophyta, but are destitute of animation and the power of locomotion, and zoophyta are, as it were, plants, but furnished with sensation and the organs of spontaneous motion Of these some are [illegible] and naked, and others are covered with a hard shell the former are by some naturalists called zoophytes, and the latter are denominated lithophytes

The coral reefs that surround many islands particularly those in the Indian Archipelago, and round New Holland are formed by various tribes of these animals, particularly by the Cellepora, Isis, Madrepora, Millepora, and Tubipora The anim[illegible] in these corals with such rapidity that enormous masses of them very speedily appear where there were scarcely any marks of such reefs before

ZOSTERA, a genus of plants of the class gynandria, order polyandria, and in the natural system arranged under the second order piperitæ There is one species

ZWINGERA, a genus of the class and order of plants decandria monogynia There is one species, the amara, resembling quassia, a shrub of Guiana

ZYGÆNA See Squalus

ZYGIA a genus of insects of the order coleoptera The generic character is antennæ moniliform, feelers equal, filiform lip elongated, membranaceous jaw one toothed

ZYGOPHYLLUM *bean caper*, a genus of plants of the class of decandria and order monogynia and in the natural system arranged under the 14th order gruinales There are 11 species, partly shrubby and partly herbaceous plants, all natives of warm climates though some of them are hardy enough to endure the open air in this country

ZYMOSIMETER an instrument proposed by Swammerdam for the purpose of measuring the degree of fermentation occasioned by the mixture of different substances and the degree of heat attending such fermentation

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